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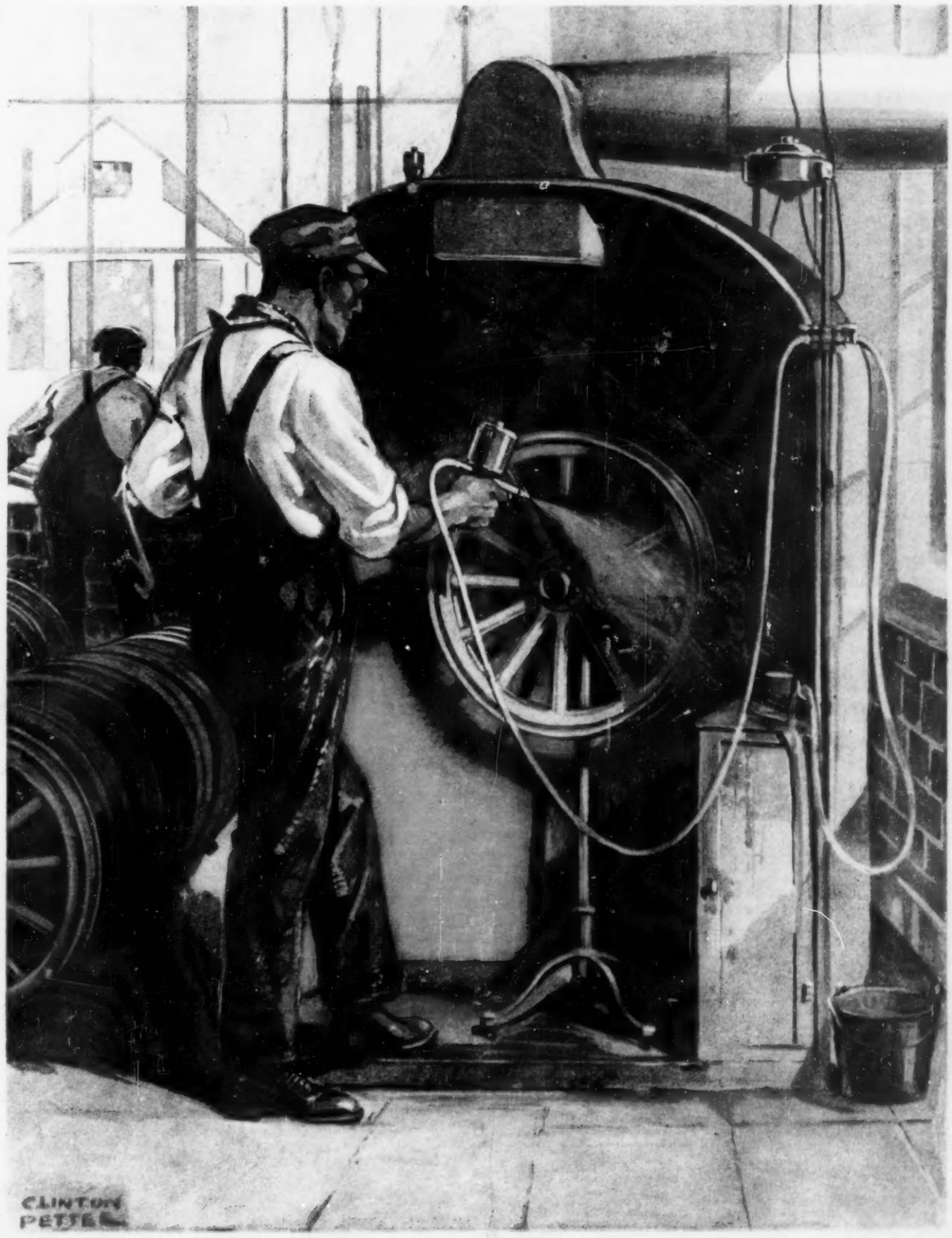

PAINTING AUTOMOBILE WHEELS WITH A JET OF AIR—[See page 14]

Vol. CXXI. No. 1
July 5, 1919

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Price 10 Cents
$5.00 a Year

Owners' Records of

100,000—200,000—300,000 MILES

THE ultimate mileage of White Trucks is still unmeasured. Some have rounded out 300,000 miles. Many have run 200,000 miles. Hundreds, probably thousands, have passed the 100,000 mark.

White Trucks roll up mileage years after the best ordinary truck is worn out. In the long run they involve less investment. Fewer units are required to do the *work*. They put off the day when new trucks replace them.

Operating and maintenance costs are also lowered by the steady volume of performance which makes high mileage records possible.

"100,000 Miles and More" is the title of a booklet containing owners' records of hundreds of White Trucks which have run more than 100,000 miles. A copy will be sent to anyone interested on request.

WHITE TRUCKS

THE WHITE COMPANY, *Cleveland*

PROTECTED BY
UNITEDSTATES
PATENTS

June 28, 1904
Aug. 31, 1915
Mar. 14, 1916
Feb. 19, 1918

Caterpillars Add to the Life of a Truck

Aside from their extraordinary traction qualities and ability to deliver mileage, the most frequent comment we hear from truck owners who have put Kelly Caterpillars on their trucks is that the trucks go less often to the repair shop.

The reason for this is simple.

The Caterpillar's unusual depth of rubber and patent-protected system of side vents make it much more resilient than the ordinary type of standard truck tire. Instead of passing along road shocks to the engine and chassis it absorbs them.

After all, saving the truck is the most important function of a truck tire. That is why the owners of many of the biggest fleets in America have changed to Kelly Caterpillars.

Kelly-Springfield Tire Co.

General Sales Department

4614 Prospect Ave. Cleveland, Ohio

KELLY SPRINGFIELD TRUCK TIRES
CATERPILLAR TREAD

Packard First Cost and Final Economy

FINE automobiles were long made and sold as luxuries.

Some men cannot yet grasp the idea of economy and sheer utility-value beyond a certain fixed first cost.

Their motoring ideals are limited. Their car imagination stops about half way.

These men have not kept pace with engineering development as represented by the Packard Twin Six.

Leaving aside the factors of elegance, beauty, speed, riding comfort, they would not understand how the Packard, for example, would be worth a two-fisted man's money, even if he took care of it himself and, let us say, drove it in his shirt sleeves.

On the highroad, or in city traffic, it is the easiest car in the world to handle; the best car for either man or woman to drive; the most responsive, accurate and safe.

The Packard has a much longer natural life than other cars.

It costs less to maintain than compromise-cars at one-half to two-thirds its price. It does not need the constant care of a mechanician.

Every part is accessible.

Adjustments are so simple, the whole mechanical lay-out so clean-cut, that any man or woman who has been about cars at all and knows enough to handle a wrench can keep it running sweet and strong as the day it was delivered.

The Packard does everything easily, without racking vibration, without effort, without strain. There is nothing inaccessible, awkward or amateurish about it.

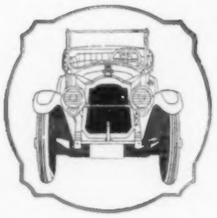
It is a developed car; professional through and through. All the power you can use, but never any wasted.

Any man could see the advantage of all this in relation, say, to the power equipment of his factory. Why should he think he can compromise successfully in his motor-car investment?

* * *

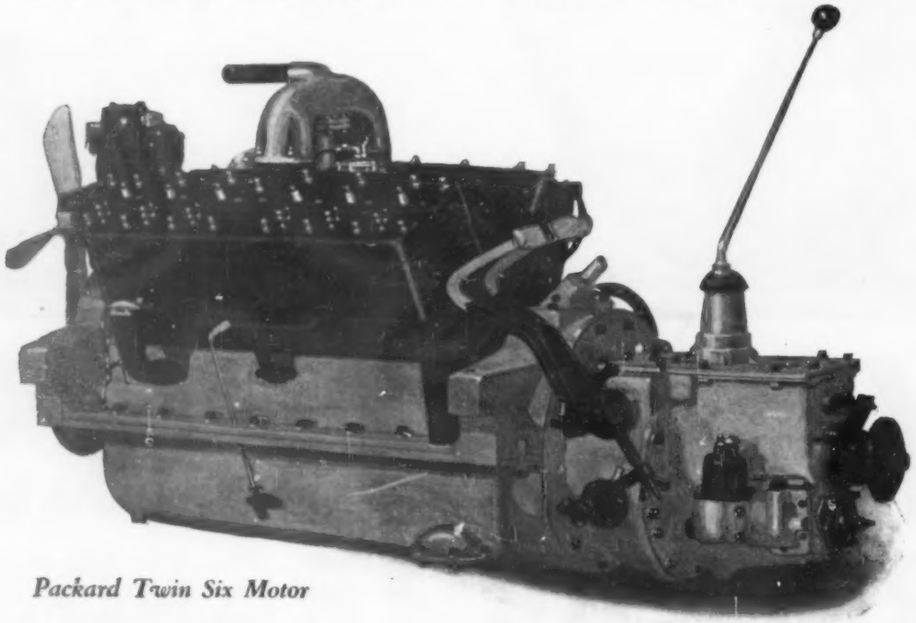
There is a new science of transportation—that of motor-vehicle performance, maintenance and cost. It has to do with your car and its duty, however limited its use.

The Packard people are transportation experts; they have more to tell you on this subject than any other organization in the world. You can ask them to discuss your car problem without obligation. It is to your interest and profit to do so.



"Ask the Man Who Owns One"

Judged by the number of years you will use the Packard, as against the life of another car—a Packard costs less than an ordinary automobile. The total cost includes not only the original cost, but supplies, repairs and upkeep—against which you can credit the assured high used-value of a Packard Car.



Packard Twin Six Motor

PACKARD MOTOR CAR COMPANY, *Detroit*

SEVENTY-FIFTH YEAR

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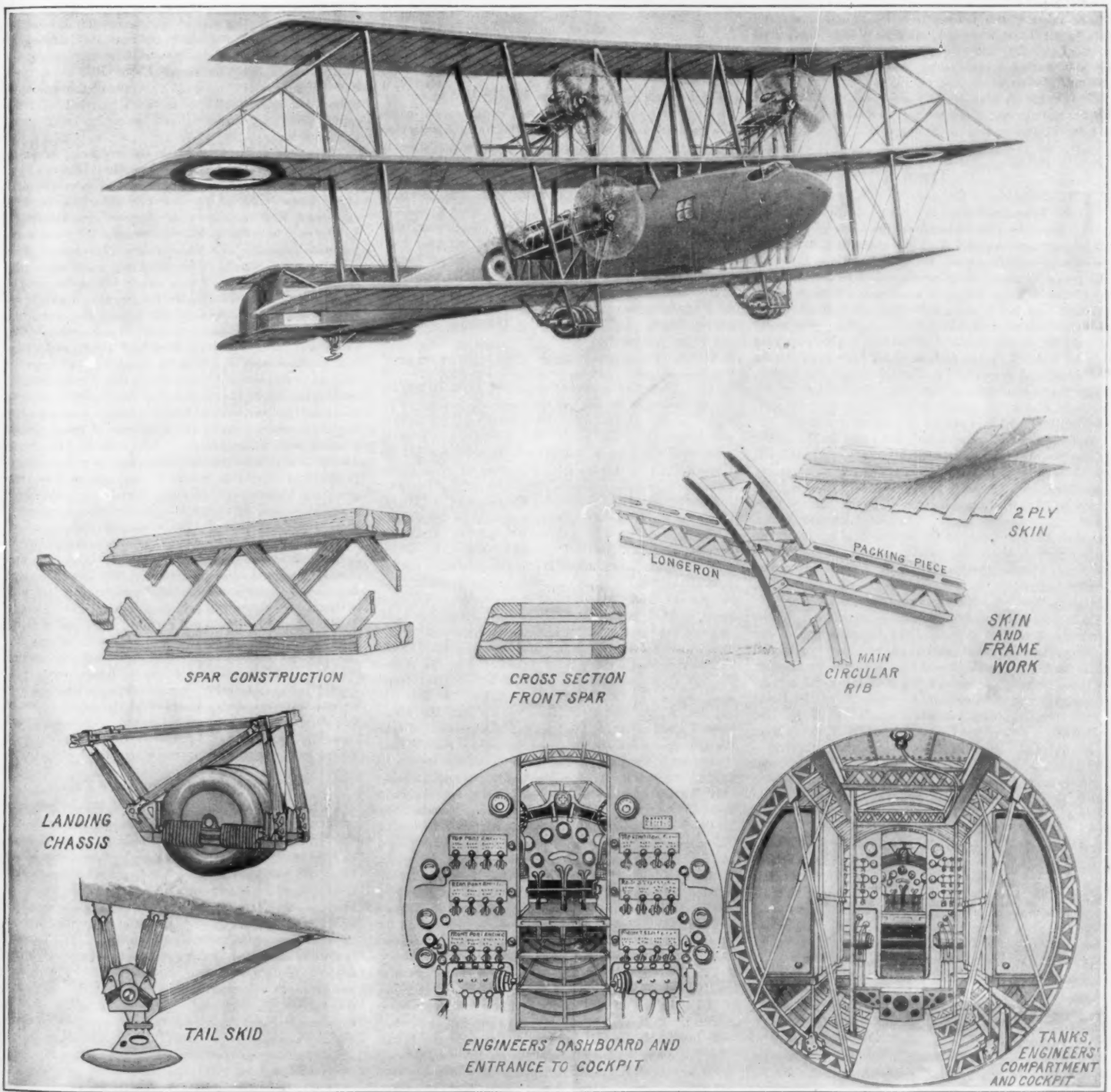

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The largest airplane yet constructed—the Tarrant Triplane—as it will appear in flight, and some of its most striking constructional features—**(See page 10)**

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Peace

THE signing by Germany of the Treaty of Peace at Versailles brings to an end the War of Arms begun by the Germans on the fields of Belgium. So long as Germany and the Allies abide by the terms of this momentous document, the thunder of the guns and the tramp of armed peoples will never be heard. The wheels of industry will turn with their one-time speed; rail and road will be alive with their accustomed traffic; and the fleets of the world will come and go, once more, on all the seven seas. And although the returning warrior will not, in the fashion of his forbears, hang up his shield and spear, or his flintlock above the hearth, he will carry, deeply graven upon the tablets of his memory, sights and sounds of this ferocious world war, that will confront him as long as memory endures.

But the material peace which has come by the stroke of the pen at Versailles is, after all, but an outward and visible sign of a peace, secret, unwritten, but eagerly hoped for, without which the Versailles document may prove to be but one more scrap of paper. If the vanquished nations who, by their accredited representatives, set their hand and seal to the covenant of peace, did so with a hatred, blind, unreasoning and implacable in their hearts, it will be merely a question of time and opportunity before the armed multitudes will be on the march and red ruin will stride again across the world.

It is our firm belief—for there is no evidence to the contrary—that the nations of the Entente, in this the supreme hour of accomplishment, are more concerned with the healing of the world than with the humiliation of the enemy. In reviewing the long-drawn-out horrors of the war and the interminable anxieties of the Peace Conference, the dispassionate historian of the future will write it down that the nations of the Entente were animated and sustained by two absorbing motives—or ambitions, if you will—first, to save Civilization, and then to make it secure. Civilization was saved by the unconquerable courage and endurance of the Entente armies during four and a half years of the bloodiest fighting the world has ever known; it was made secure, for the time being, when the labors of the Peace Conference were sealed by the approval of the men who had set Civilization at defiance. We say "for the time being"; for the enduring quality of the peace thus secured is a matter for Germany to decide. If we shall have to deal with a disillusioned but unrepentant Germany, the peace of the world, so far as she is concerned, is a sacrilegious sham—a machiavellian mockery.

We repeat that the question of ultimate peace or war is one for Germany to decide; for in voluntarily banding themselves together in a League of Nations the Entente has gone on record as unalterably opposed to war. Through the League it hopes to substitute reason for force, confidence for distrust, fair dealing for trickery, and an enlightened sense of common interests for the old international aloofness.

The Peace Treaty, with its heavy penalties and restrictions, is merely a vindication of that international morality, which our one-time enemy so ruthlessly set at defiance. It no more breathes the spirit of persecution than does the judge who pronounces sentence in a criminal court. Clear proof of this is seen in the provision that, if Germany shows evidence of sincerity in carrying out the terms of the treaty, she will be admitted to membership in the League. In respect of sincerity, alas, she has made a very poor start. For in her notification of acceptance, she arrogantly stated she was signing, under compulsion, a treaty whose terms she never expected to fulfill; and in the same hour she placed the crowning mark of dishonor upon her unparalleled record by breaking her parole and sinking her interned fleet.

It is stretching charity to the limit to express the hope that these things have been done blindly in the anguish of an extreme hour of humiliation. Let us hope that sober second thought will teach the Germans that the winning back of the confidence of the world does not lie that way.

Congress and Our Naval Air Service

IS it possible that Congress has already so far forgotten the lessons of the war as to repeat, in the matter of appropriations for the Naval Air Service, the policy of neglect and indifference which it pursued in regard to the naval sea service, with such fatal results, in the years preceding the war.

This interference of Congress with the technical questions of the Navy is a matter of history, and the facts are so well known that we refer to the matter again only because history is already beginning to repeat itself in a new field which promises to be of supreme importance in the future naval operations. We refer, of course, to the difficulty which Mr. Daniels is having in persuading Congress to grant his request for a very modest appropriation of $36,000,000 for the development of our Naval Air Service.

That the sum named is modest will be apparent when we bear in mind that Great Britain has appropriated, without a word of protest, the sum of $332,500,000 for the British Air Service. This vast amount is to be taken as the well-considered estimate of the decisive role which the dirigible and the airplane will play in preserving the integrity of the widely-scattered British Empire. That estimate is based upon no mere guesswork, but upon the wide experience of four years of war.

Now Mr. Baker, who is asking for an army of 500,000 men, has received the tentative approval of the Senate of an appropriation of $55,000,000 for the Army Air Service; and Mr. Daniels is asking for our Navy, which when its three-year program is completed, will be not far behind the British Navy in strength, an appropriation of $36,000,000. These two appropriations together reach a total of $91,000,000, or considerably less than one-third of the sum which has been freely voted for the British Air Service, which includes both army and navy.

The fact that Congress, as represented in the House Naval Committee, allots $600,000,000 for ships, personnel and accessories, and only $15,000,000 for the Air Service, shows that it is again falling into the error, always disastrous, of interfering in the question of how its appropriations shall be distributed—a matter that should be left entirely to the discretion of the Secretary and his technical advisers, the General Board and the Aid for Operations. To cut down the appropriation from $36,000,000 to $15,000,000 is to reduce the efficiency of the fleet by a like proportion. It betrays an amazing failure on the part of the House Committee on Naval Affairs, to grasp one of the outstanding lessons of the war.

Admiral Jellicoe, in his work on the Grand Fleet, tells us that for gathering information about the strength and position of the enemy one dirigible is equal to two cruisers. Which, translated into dollars, means that for $1,000,000 expended on air scouting you get five times the value of $1,000,000 spent on sea scouting.

Nor does the value of an adequate air service cease with the matter of scouting. Of equal, if not greater value, will be the use of fast airplanes in the matter of fire-control. In these days of long-range gun-fire, the enemy will frequently be hull-down to the men in the turret. No longer will the fall of the shells be determined solely by a spotter at the top of the mast. It will be observed by airplanes, dispatched from the firing ship; and these, from a position above the enemy, will send in the corrections with an accuracy never dreamed of in the pre-war days.

The reasonable sum asked for by Mr. Daniels is to cover the purchase of two dirigibles, similar to the one which is about to visit our shores, and a few of the fast little observing machines which the British developed and used in the North Sea operations. With these as a basis, the Navy proposes to develop its own designs and build the necessary stations for their housing and for future work of development.

The practise of economy by Congress just now is altogether commendable; but it should be done with proper discretion and entirely under the advice of the Navy's technical advisers, who alone are the competent judges as to where the pruning knife can be used with least hurt to the service.

Concrete and the Shortage of Houses

THE present very serious shortage of houses is one of the legacies of discomfort left behind by the war. For three years past the building of apartment houses and smaller dwellings has been practically at a standstill, not merely in the cities but in their outlying suburbs. The great demands of the war both upon labor and supplies of material, coupled with the rapidly mounting costs of both, served to bring about these conditions.

The public at large, which is not overmuch given to consideration of the laws of economics, believed that when the war ended there would be a rush on the part of the house builders, speculative or otherwise, to meet the great and ever-growing demand for dwellings. In this they have been disappointed, and the reasons are not far to seek. For the builders in common with many other people have been holding back, under the delusion that there must be a speedy fall in the price of labor and materials, failing to realize, that if people refuse to spend their money, whether in the store, the market or in the larger constructive activities of life, prices will remain at the present high level indefinitely.

If the builders will only grasp this truth and have the courage and common sense to start their operations immediately, despite the existing high prices, they need have no anxiety on the score of finding tenants willing to pay rentals proportionate to the high cost of construction. Furthermore, if the people at large can be brought to realize that refusal to purchase, due to a belief that prices must inevitably fall, is the one sure way to keep prices up, a great step will have been taken in the direction of loosening up the present intolerable conditions.

In this connection the question may well be asked, what has become of the many cheap systems of concrete house building of which so much has been said and written during the past few years. Mr. Edison himself is or was an ardent advocate of concrete as the ideal material for the construction of one and two-family dwellings, and he developed certain simple methods for putting up suburban dwellings quickly and at very low cost. What has become of these and other plans which should be ideally adapted to meet the present crisis? Furthermore, if steel and concrete construction has proved to be admirably adapted to the construction of tall loft buildings, why should it not offer a rapid and economical solution for the present shortage in tenement houses and even in the more expensive apartment houses?

The Myth of the Monkey Chain

AN interesting article by Prof. E. W. Gudger, in a recent issue of *Natural History*, deals with the time-honored story on which most of us were brought up that South American monkeys are in the habit of crossing alligator-infested streams by linking their tails and legs to form a living bridge. Pictures of this feat once figured extensively in the school geographies and Professor Gudger reproduces such a picture from a Fourth Reader published as late as 1897. The story was first told, so far as known, by the Jesuit priest Padre José Acosta in a work published in 1589. Several later writers have repeated the tale. The first person to dispute its veracity was Baron Humboldt. Recent explorers of South America, when they mention the story at all, express scepticism. Finally, Messrs. Leo E. Miller and George K. Cherrie, of the American Museum of Natural History, who have done so much traveling and collecting in South America, have suggested to Professor Gudger a plausible origin for such tales. They think that the story of the "monkey bridge" has come about through observation of a procession of monkeys crossing a ravine or stream on a pendent liana.

Naval and Military

To Prevent Fouling of Gun Barrels.—A method of overcoming the fouling of gun barrels, as described in the Journal of the United States Artillery, consists of introducing in the chamber of the gun an alloy of 60 per cent tin and 40 per cent lead by weight, which breaks up at the moment of firing, the tin uniting with the copper in the bore of the gun, and the lead acting as a lubricant for the succeeding rounds and tending to granulate and assist in the removal of the fused brass alloy formed by the above mentioned reaction.

German Navy as Intended, and As It Is.—According to the German Navy Law Amendment Act of 1912, the fleet to be fully commissioned in 1919 included 25 dreadnoughts, 9 battle-cruisers, 4 pre-dreadnoughts, 21 light cruisers, 99 destroyers, and 54 submarines—an active personnel of 100,000 and a reserve of 80,000. The actual strength in fully commissioned ships in 1919 according to the Peace Treaty consists of 6 pre-dreadnoughts, 6 light cruisers, 12 destroyers and 12 torpedo boats, with a personnel of 15,000 and no reserves.

Reduction of French Commissioned Fleet.—France is greatly reducing her naval expenditures notably in the matter of placing fighting ships in reserve. The early ships of from 1885 to 1889 will be condemned, and of modern units the 18,000-ton "Voltaire" and the 24,000-ton "Bretagne" classes have been put out of commission. The battle force now includes only the eight ships of the "Lorraine" and "Democratie" classes. Seventy-five of the destroyers and over 50 per cent of the submarines have been placed also in reserve and some 200 patrol boats have been disarmed.

The Army Is Well Furnished with Ordinance.—If the war, as expected, had lasted into the year 1919, ordnance for our army would have been pouring into France on an enormous scale; for the War Department had $14,000,000,000 worth of orders for ordnance on its books, of which about half had been practically completed when the armistice was signed. It was enormously costly work; but it has left us with a magnificent reserve of ordnance as a safeguard for the future, and all of it is thoroughly modern and includes the latest developments of the war.

An Army of 500,000 Men.—Secretary Baker in asking for a permanent army of 500,000 men should have behind him the backing of the whole country, otherwise it will seem that we have failed to learn the lessons of the great war. Had the United States commenced to prepare for the inevitable conflict two and a half years before it did, the war would have been greatly shortened and millions of lives and billions of property would have escaped sacrifice. Until it can be seen how the world is going to shape out in the future, and only when the League of Nations shall have had time to prove its ability to bring about a further reasonable disarmament, it would be wise to maintain the strength of our army at the figures suggested by the Secretary of War.

Coast Guard and the Navy.—The Navy wants the Coast Guard to be incorporated with itself and the Coast Guard personnel are in favor of being thus incorporated. A vote taken last March at a meeting of the commissioned and warrant officers of the Coast Guard showed 59 in favor of amalgamation with the Navy and two against. A vote of the entire service gave 339 in favor and four against amalgamation. The Navy needs the experienced and well-trained officers and men of the Coast Guard Service to assist in carrying on the heavy duties which have been thrown on the Navy by war conditions. Performance of the important coast guard duties affords a school of training in coastal navigation and steamship practice that can be had in no other way.

British Wholesale Disarmament.—That Great Britain has set about the work of disarmament in good earnest is revealed by the announcement that she is going to sell over 160 vessels of her existing fleet. The most striking feature is the total elimination of her pre-dreadnought battleships, all of which with the exception of the two latest of the "Lord Nelson" class, which may be considered as belonging to the semi-dreadnought group, are to be stripped of their guns and sold with a proviso that they are not to be used for military purposes. The balance of the sale will be made up of cruisers, destroyers and gunboats. Thus not only is the British fighting strength reduced but the condemned ships will represent a large subtraction from the total of the world's fighting ships, since they will figure in no other navy list.

Science

Scientific Publications from Germany.—In consequence of special arrangements made through the efforts of the American Library Association, many libraries have been importing German scientific books and journals from neutral booksellers for some months past. It is now announced by the War Trade Board that applications will be considered for licenses to import into the United States, from Germany or elsewhere, scientific books and journals published in Germany. In order to obtain such a license, however, the importer must arrange to make the purchase price of the publications available for the purchase of foodstuffs for Germany, by depositing the money with the American Relief Administration for remittance to the persons entitled thereto. Where German publications were bought and paid for prior to April 6th, 1917, payment to the American Relief Administration will not be required.

Airplanes for Fire Patrol of the Forests.—After some preliminary reports concerning the possibility of using airplanes as an auxiliary in the work of protecting forests from fire, it is now definitely announced by the U. S. Forest Service that the Air Service and the Forest Service will coöperate in work of this character during the coming summer in portions of the national forests of California, Arizona, New Mexico and other states. Army airdromes and bases will be used for the undertaking, which will be largely experimental during the coming season. Besides supplementing the work of the forest rangers in locating forest fires, attempts will be made to utilize aircraft in connection with fire-fighting. One plan to be tried is the use of bombs filled with suitable chemicals as a means of extinguishing fires from the air. It is also suggested that fire-fighters may be carried to the vicinity of fires in dirigibles, and lowered to the ground by means of ladders. Airplanes will use wireless in reporting the location of fires.

New Scientific Departments at Cambridge.—Some of the leading oil companies and capitalists of Great Britain have agreed to supply funds amounting to £210,000 for the purpose of establishing a chemical school at Cambridge University. Another notable scientific development at Cambridge is the plan now on foot to establish at that university a British Geodetic and Geodynamic Institute. A committee of eminent scientific men has been formed to undertake the raising of a fund of £50,000 for this purpose, of which £20,000 is for the purpose of endowing a university professorship of geodynamics, to be held by the director of the institute. The plan of establishing such an institute has been under consideration by the British Association for the Advancement of Science for the past three years. As an illustration of the need for a British establishment of this character it is stated that, before the late war, it was the custom of many British surveys (notably the Survey of India), when confronted with difficult geodetic problems, to refer them to the Geodetic Institute at Potsdam.

Surgical Sphagnum in Eastern Maine.—Sphagnum moss suitable for surgical dressings occurs in great abundance in the Pacific Northwest, but seems to be relatively scarce in the eastern United States; though abundant supplies have been obtained from southern New Brunswick and parts of Cape Breton. During the summer of 1918, Prof. George E. Nichols, of Yale University, undertook to investigate eastern sources of sphagnum on behalf of the American Red Cross. The most promising region appeared to be the coast of eastern Maine, where many "raised bogs" or "high moors" prevail. Professor Nichols spent a month in exploring this region. Considerable amounts of *Sphagnum papillosum*, the best species for surgical use, were found on the raised bogs, but its occurrence was mainly restricted to the margins of ponds and to wet degressions, rather than the dry areas that form the greater part of the bog surface. By far the largest quantities grow in the wet, flat, "floating" bogs that border lakes and ponds. Unfortunately lumbering has brought about the destruction of many of the best areas of surgical sphagnum in eastern Maine, as it has been drowned out by the damming of the streams and the regulation of the water-flow. In the blueberry districts the repeated burning over of the country in the interest of the blueberry crop has had a disastrous effect on the sphagnum.

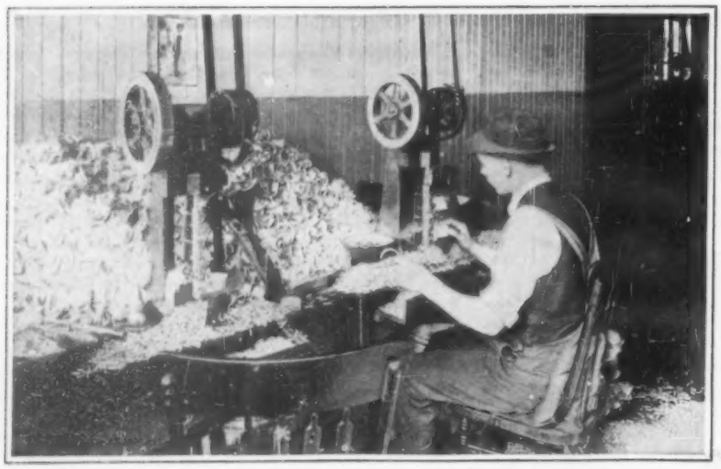
Automobile

Enormous European Fuel Importation.—Figures recently published make clear the great consumption of motor gasoline for war purposes by the Allied nations. The imports of the United Kingdom increased from 38,000,000 gallons on January 31st, 1918, to 89,000,000 gallons on January 31st, 1919. France was second with an importation of 67,000,000 gallons up to that date while Italy had received about 34,000,000 gallons. Our neighbor, Canada is debited with 10,000,000 gallons so it is no wonder that, because of the enormous increase in consumption at home and abroad, all American motorists who were willing to prove they were good Americans were asked to participate in a few "gasless" Sundays.

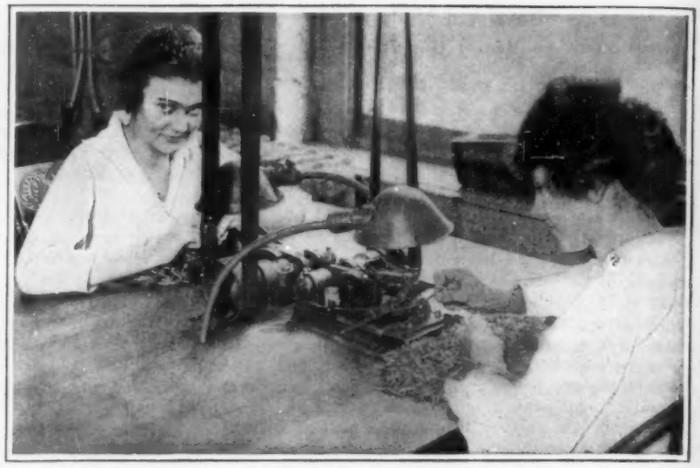
Lateral Clearances.—In those parts of any machine which have a slight back and forth as well as rotating motion, as an automobile crankshaft, the end play should always be sufficient to prevent any possibility of restricted action to the piece, otherwise connecting rod brass readjustment, wearing out of the parts, or other unlooked for difficulties may result in heating trouble. There is no practical virtue in cutting clearances too fine, although there are undoubtedly situations where the minimum amount of clearance must be looked to. In many cases adjustments could be made to rectify clearance discrepancies, but even if this is possible it is not a procedure to be recommended because any adjustment that has been given to the part, is there for some other definite reason, and the elimination of this may absolutely upset everything when the need for legitimate adjustment has to be carried into effect. In most cases these existing allowances cannot be tampered with without creating trouble and a depreciation which may involve considerable risk in the liability of injuring the working parts.

New British Small Cars.—The great vogue of the popular-priced small car in this country and the quantity production methods of our manufacturers which make this possible is not lost on English and French manufacturers. A new light car of British design is offered at the price of $2,000 for a standard touring model of the four-cylinder type rated at 20 horse-power. As is true of European ratings, it is rather conservative as the power plant will actually develop 45 horse-power. The wheel base is 129 inches and the approximate weight of the chassis will be 2,000 pounds. The plant in which the car is to be manufactured has grown greatly during the war and employed 25,000 persons. It is strange that these vast resources cannot produce a lower priced car than that developed as there are a number of American makes that sell for less than that, having six-cylinder engines of fully as high power. However, this is a marked reduction in price for a car of this quality of European manufacture. It would seem that what is really needed to popularize motoring in Europe is an able small car selling for less than $1,000 instead of the more costly models.

California Distillate.—Many Eastern motorists are asking what "distillate" motor fuel is and where it can be procured. In response to an inquiry the Bureau of Mines of the Department of the Interior has stated that the petroleum product manufactured in California and marketed extensively in the West under the name of "distillate" or "engine distillate," is obtained as follows: The crude is heated or "topped" in various types of stills or topping plants until the vapors reach a temperature of 400 to 500 degrees Fahr. The condensed vapors, "tops" or "first-run distillate," are rerun in steam or combination steam and fire stills, yielding the following products in the order named: Gasoline, engine distillate, stove oil, steam still bottoms. In most cases, the engine distillate is agitated with a sufficient quantity of concentrated sulfuric acid to make it water white, and then washed with caustic soda and water before marketing. Hence distillate or engine distillate is a refined rerun product coming between gasoline and kerosene. Its gravity is as a rule very close to 50 degrees Baume (0.7796 sp. gr.) although a 52-degree distillate (0.7711 sp. gr.) is also marketable. It will be evident that it will operate an automobile engine very well in a warm climate but that its value in a section of the country where the weather is cool or cold a large part of the time is not as great as that of the more volatile gasoline to which Eastern motorists are accustomed.



Splitting large bamboo sections into triangular blanks for phonograph needles



Feeding the needles, one at a time, into the pointing machine

Phonograph Needles of Bamboo

Some of the Manufacturing Details Involved in the Search for Softness of Tone

THE true inventor is never satisfied with anything that is; he is driven by his every impulse to seek ways of improving everything with which he comes in contact. The phonograph, in its infancy some 10 or 15 years ago, might by all good rights have seemed to the layman a sufficiently wonderful development of the mechanical arts, and anyone might well have been excused from trying to make its reproduction of the human voice better than it was. But such a point of view would be quite out of the question on the part of a person with the inventive instinct.

So when F. D. Hall, of Chicago, became interested in the talking machine to the point of installing one as a feature of his domestic establishment, he immediately asked himself whether he could not do something to make it work better. And from his point of view, this query was a just one. Those of us who remember the phonograph of 15 years ago, if we are frank with ourselves, will have to admit that its tone left a good deal to be desired. It was tinny and harsh; it was unduly loud. Noises of mechanical origin appeared unnecessarily audible. And surely there ought not be such wear on records that were so fragile and so costly.

Mr. Hall did not concern himself with the instrument. He realized that radical advances could and doubtless would be made here; but this would take time, and a very large amount of experience and familiarity with the instrument and its workings. But, he asked himself, might not something be done at once to better the connection between the soundbox and the record? The tone must somehow be improved; could it not be done by substituting, for the metal stylus, some fibrous substance of less natural harshness?

First thoughts, as might be imagined, revolved entirely around wood. One variety after another, shaped this way and that, was experimented with; and each in its turn developed shortcomings that resulted in its rejection. Finally the inventor turned to bamboo and with this material he scored his first success.

Bamboo is not properly speaking a wood. It is a grass, native to the Orient, and best cultivated in China, Japan and India. Its tough, cellular composition and its glassy exterior surface eventually led to its adoption as the best material for the newly conceived stylus. And the problem of the rightful shape for the needle was at once solved by the bamboo's nature.

Only by keeping the enamelled cortical surface outside at the point of the needle could the requisite degree of hardness be secured. Plainly splitting was the easiest and most effective method of thus dividing the substance, with its long even fiber. What then could be more logical, more economical, than triangular splits, each a section of the naturallycylindrical, section-sawed bamboo? And so, when experiments had demonstrated the correctness of bamboo as a material, the wisdom of the prism shape and the general soundness of the fiber needle as a whole, patents were obtained and manufacture begun.

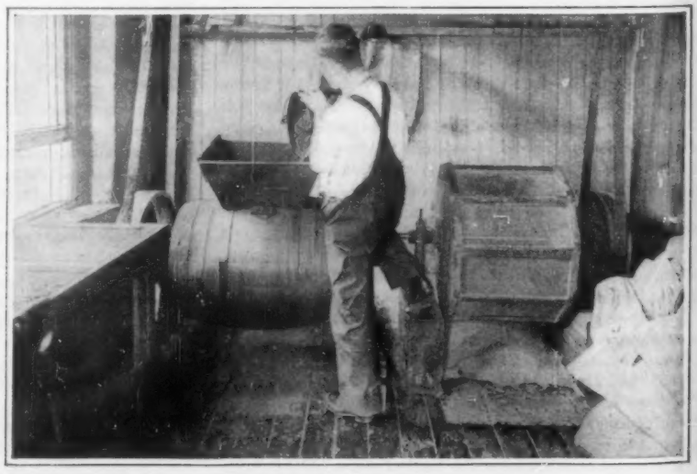
As is so often the case with small things, the fiber needle of today is deceptively simple in appearance. There are many details, surprisingly involved in some cases, that come to light on a trip through the factory. To begin with, the selection of the material is a matter of no small importance. The poles must be 20 feet in length and from 2½ to 3½ inches in diameter—about four times the size of the ordinary fishing pole. They must be of relatively flawless exterior. Even the packing is closely supervised, to guard against mishaps to the delicate surfaces in transit across an ocean and half a continent.

The first step in the manufacturing process is the sawing of the poles into sections about an inch long, which in turn are split in two. These are placed in specially devised machines and further split into crude blanks for single needles at the rate of from 125 to 180 per minute. Each blank is forced up by the splitting of the succeeding one, and conveyed ultimately through a gravity chute to a bin below. In this process the inner or pithy part of the bamboo is eliminated, only the outer shell going into the manufacture of the needles.

Bamboo is by nature a peculiarly "live" type of vegetable growth. Its myriad canaliculate cells are filled with sap, or honey as the natives call it. This must be forced out and replaced with essential oils and waxes, in order to render the bamboo impervious to the harmful action of moisture. Drip-kettles are laden with needles, and slowly lowered on block and tackle into vats of a scientfically prepared oily mixture heated to some 340 degrees Fahrenheit; and this bath is continued intermittently for about 40 minutes. The blanks are then transferred into tumbling barrels for the purpose of cooling, absorbing excess oil, and with the further object of polishing. The barrels contain hardwood sawdust, which has been carefully screened and sifted to a rather coarse texture. Were the finely pulverized wood flour not thus eliminated from this polishing medium, it would adhere to the tiny splits whenever the cooling process was accelerated a trifle beyond normal.

And still the needles are not really needles—they lack, as yet, their points. Each of the little bamboo shafts must be pointed by hand. The prism-shaped pieces are inserted into a triangular bushing on a cutting machine of original design, placed so as to insure a perfect point running out to the cortex side of the bamboo. Each of these machines has a capacity of some 30,000 needles per day. After this final operation, the needles are inspected, counted (by weight) and packed into the envelope containers in which they are sold.

The seasoning process. Each drip-kettle holds 100,000 needles



Polishing the needles in a mixture of hardwood sawdust and wax

Rattan—Its Source and Its Services

DOUBTLESS every one of us realizes that there is some distinction to be drawn between bamboo on the one hand and rattan or cane on the other. Yet it will come with a distinct shock of surprise to many of us to learn that the member of the vegetable community from which we get rattan is a climbing palm—a double surprise, in fact, that rattan should come from a climber and that a climber should be identified as a palm. Yet such is in truth the case.

The name which the botanist associates with the rattan of commerce is Calamus. This is a large genus of slender, leafy, climbing palms, natives chiefly of Siam, Indo China, and the islands of Borneo, Java and Sumatra. While keen climbers, they are not clingers or creepers such as we ordinarily think of in connection with that term; they ascend the trunks of their hosts by means of stout reversed thorns upon their leaves. These leaves are really a sort of sheathing husk about the entire calamus stem, so that the thorns give a tremendous grip, which can hardly be disengaged by any accident of nature short of human intervention.

When these husks or leaves are removed there remains a slender-jointed, polished cane, much like the bamboo in general appearance, but generally smaller. Whole, these are used extensively by the natives in bridge building, as well as for furniture, carts and rigging of vessels, and some species are stout enough for walking canes. When split they are available for a wide variety of uses; in particular, the outer or bark strips become the cane with which our chairs are seated, while the inner or pith strips, by virtue of their extraordinary pliability, have wide use in basketry.

In normal times the bulk of the world's rattan manufacturing has been carried on in Germany. Since the beginning of the war France, as the second maker of rattan goods, has been called upon to supply the market; and she has done this to such good effect that she has high hopes of retaining the industry permanently. In addition to this, the French rattan factories are proud of their record as aids in the conduct of the war. They produced at least two essential articles in very large quantities—the mats necessary for the emplacement of guns in marshy ground, and the light cases in which certain types of shell were packed and transported. Moreover, in the establishments for the education and industrial employment of the wounded, especially the blind, great quantities of rattan are employed in chair caning and miscellaneous manufacturing, and all this has to be worked up from the raw state in the rattan centers.

This working up is a rather interesting process. The cane is imported, and goes to the factory, just as it comes from the stand. The shoots are first carefully washed, and then freed of the sheathing of leaves. The stems are next sorted, first by color, then according to size, millimeter by millimeter. Then after a thorough soaking the rods pass to the splitter, which splits off the bark, together with such of the body as may be desired, and cuts it into strips of appropriate size. These strips pass to the planer, where the irregularities of conformation are removed, and each strip made of uniform thickness and smoothed down so that the basket makers may work with it expeditiously. The immediate product of this operation, consisting largely of the bark, is called spun rattan; the internal part which remains goes under the name of rattan pith.

Production of Ferro-manganese in the Blast Furnace

THE Bureau of Mines points out that the operation of a blast furnace is highly empiric. Past furnace records and previous experience are nearly as essential to successful operation as are good coke and a hot blast. This is the case even with a comparatively simple and known process like the production of pig iron; in connection with a new and relatively complex undertaking like the manufacture of ferromanganese it is even more notably true. Yet in such a case the volume of records and experiences does not exist.

The climbing palms from which rattan is got (the climbers, not the trees)

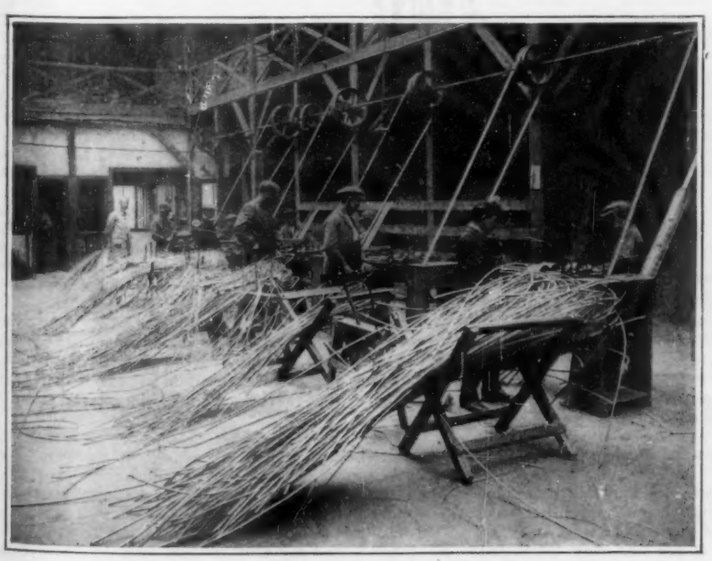
The Bureau has accordingly gone to much effort to gather all the records known to exist on this subject. The attempt has been made to have this investigation cover the widest possible range of materials and operating conditions. Data from 18 furnaces is presented, the information having been obtained in the summer of 1918, and including every American furnace in blast that was engaged in making manganese alloys, with two exceptions. With the coöperation of the School of Mines of the University of Minnesota the Bureau has just published this information in the form of a large pamphlet which it is hoped will be of value to the furnace operator. The Bureau points out that, without even agreeing with any generalizations and conclusions adduced, the operator can certainly determine from the tables presented just what has been done by others with raw materials and furnace conditions approximating his own.

Those interested in this publication should apply to the Bureau of Mines for a copy, under the title "War Minerals Investigations Series, No. 5; Production of Ferro-manganese in Blast Furnaces."

The Current Supplement

THE increasing interest of people in all walks of life in the mysterious wireless telegraph and telephone, was put under temporary restraint by the necessities arising from our state of war. These restraints may soon be wholly removed and enthusiasts will probably soon resume their activities along this line of study. We may therefore confidently predict that the very useful and interesting series on *Experimental Wireless Telegraphy and Telephony* with its clear and easily understood illustrations, beginning in the SCIENTIFIC AMERICAN SUPPLEMENT for July 5th, 1919, will appeal at once to all who have or contemplate installing outfits for this work. The first installment presents some elementary principles regarding the apparatus and means employed in radio-communication. Lovers of the curious in Nature will find the abundantly illustrated contribution on *Flower Camouflage* an entertaining discussion of fascinating peculiarities developed by the struggle for existence among California flowers. We have a familiar example of camouflage in the Dogwood of the Eastern woods, but California furnishes many more striking cases.

The ever interesting and important subject *How to Study Steel* is discussed in a general way, and the writer points out that steel must be studied in both its liquid and its solid states if one would attain a true understanding of a number of phenomena which accompany the familiar solid state. It is not generally realized that our great and larger ships are quite dependent on an adequate supply of that very dense, oily wood furnished by the *Lignum-Vitae*, and the interesting sketch concerning the properties and uses of this wood shows the vital importance of a good supply of the proper species for our navy and merchant marine. A longer article discusses the history, cultivation, preparation and manufacture of *Flax*. We grow much for seed and oil, but the textile industry has been lost in favor of certain other countries; are they more suitable for its nurture? Makers of tower clocks will be particularly interested in the brief discussion of the development of *Tower Clock Escapements* with its comparative illustration; while everyone will find the address on *Acquired Radio-activity* by the late Sir William Crookes an interesting summary of the forty-odd years of experiments on minerals and gems exposed to bombardments of X-rays, cathode rays and radium emanations. Echoes of the war tremble through the shorter article on *Physiological Sensations Produced by Detonations*, which gives some idea of what the human frame can suffer and recover from. Shorter articles include *Micrography of Aluminum; Microstructure of Iron in Electric Welds;* and a translation, *New Apparatus for Studying Fog Formation.*



How the rattan is handled in its preparation for commercial use

The manufacture of rattan shell-cases

Some American Substitutes for Rubber

Their Value from the Viewpoint of the Investor and the General Consumer

By Frederic Dannerth

THE very mention of the word "substitutes" brings to our mind a series of terms used somewhat loosely by laymen and frequently misapplied even by those engaged in technical operations. We speak of *artificial* light, as that made or contrived by art, a product of human skill and labor used in place of natural or sunlight. *Imitation* ivory is a product made to simulate more costly genuine product. *Synthetic* camphor is that made in the laboratory, having the same chemical constitution as the purified, natural material. *False* teeth are such as appear to the eye of the casual observer, to be natural; but a *substitute* for rubber is a material which can successfully replace part of the true rubber in a compound, and yield a product having many of the properties of the natural-rubber compound.

The importance of the rubber substitute arises from the fact that the finest grades and most valuable varieties of rubber grow entirely and exclusively outside the mainland of the United States. It is, therefore, most necessary and desirable to make an industrial survey of those materials which can in time of emergency be used to replace rubber in whole or in part. The materials included belong to the most divers group of substances known to organic chemists, and it is, therefore, difficult to decide on a classification which will be of value. Some of these materials have many properties in common with natural rubber while others change their character during the chemical process known as vulcanization. To enumerate them in detail we have seventeen groups.

1. *Raw oils, fats and waxes of vegetable origin.* Oils from the seed of cotton, corn, grape, flax, rape and soya. Caranauba wax.

2. *Raw oils, fats and waxes of animal origin.* Lard oil, wool grease, and beeswax.

3. *Chlorinated oil products* prepared by treating vegetable and animal oils with sulfur chloride under suitable conditions.

4. *Sulfurized oil products* prepared by treating vegetable and animal oils with sulfur at high temperatures.

5. *Sulfonated oil products* prepared by treating vegetable and animal oils with sulfuric acid under suitable conditions.

6. *Refined petroleum hydrocarbons.* Petrolatum and parafin wax. (Naphtha and gasoline are used only as volatile solvents in cements, etc.)

7. *Pitch residue from petroleum hydrocarbons.* This includes the blown or oxidized pitches covered by recent patents.

8. *Pitch residue from coal-tar hydrocarbons.* This consists mainly of aromatic or "saturated" hydrocarbons.

9. *Pitch residue from the distillation and refining of fatty acids.* This is sometimes called stearin pitch or candle tar.

10. *Pitch residues found as natural deposits.* This includes the lakes of asphaltum and the mineral deposits of gilsonite and elaterite found in Utah.

11. *Synthetic resins,* produced by condensation of hexamethylene-tetramine and of formaldehyde with phenol, cresol and related compounds.

12. *Natural resins.* Common resin obtained in refining of turpentine. Guayule resin obtained by extracting crude guayule gum with acetone. Chicle resin obtained by extracting crude dry chicle gum with acetone. Guayule and chicle are gums grown principally in Mexico and Central America. The former has about 20 per cent and the latter about 60 per cent resins.

13. *Carbohydrates.* This group includes starch, sugar, and powdered cotton. All these substances lack many of the characteristics of rubber, but are mentioned here because they are volatile in the same sense as rubber is volatile, and possess a relatively low specific gravity.

14. *Water-insoluble soaps of Oleic acid.* The aluminum, zinc and lime soaps form one group, while the lead and the magnesium oleates are grouped as accelerators, or catalysts. The insoluble oleates have a lower melting or fusing point than the other soaps.

15. *Water-insoluble soaps of Stearic acid.* This includes the derivatives of lead, magnesium, aluminum, zinc and calcium. Lead stearate is less active as an accelerator than lead oleate. These compounds can be kept in powdered form at ordinary temperatures.

16. *Animal proteins.* This group includes three types of which the elementary formulas are: C-O-H-N (for silk, glue and leather), C-O-H-N-S (for wool); and C-O-H-N-S-P (for casein of cow's milk). Of all these there is one which is of preëminent importance because it can be incorporated with raw rubber while in the colloid condition. I refer to animal glue. Experiments with casein are now in progress, and if positive results are obtained, it may become of as much interest as bone-glue for these purposes.

17. *Gums related to rubber.* In this class we have Guayule gum obtained in Mexico from the *Parthenium* shrub, and the chicle gum obtained in Central America from the *Achras* tree. Guayule gum contains naturally about 20 per cent resins and chicle contains about 60 per cent resins, the balance in both cases being mostly a gutta or gum similar in many respects to the rubber obtained from the *Hevea* plant.

The Varnish Industry

It is an interesting fact, and one not commonly recognized, that the problems of the varnish industry, are many of them similar to those of the rubber industry. As an example of this we have the well known fact that the oils and gums used in varnish manufacture must "dry" in order to be of commercial value.

In recent years, the researches of chemists have brought to light a group of "drying agents" which have to a great extent displaced the older "baking-japan" driers. I have in mind the metallic soaps: the linoleates of lead and manganese; the resinates of lead, manganese, cobalt and nickel. These substances are in effect catalytic agents which induce the rapid oxidation of the oil or varnish. They form two classes of compounds, the one containing more oxygen than the other, and they easily pass from the one form into the other. If, for example, we have a varnish containing oleo-resins and a small amount of lead resinate, and oil, the lead resinate will give up half its oxygen to the oil, and then take up more from the air. In this way the "drier," the lead resinate, acts continuously as a go-between to pass oxygen along from the air to the oil, and the result is that the oil finally becomes permanently hard, and the surface of the wood is protected. For 100 kilograms of oil, the manufacturer would use not more than 1 kilogram of the drying compound, in fact $\frac{1}{4}$ of a kilogram is in many cases quite sufficient to induce drying.

Now the "accelerators" used in the rubber industry are catalytic agents used for the purpose of carrying the sulfur to the rubber, and helping these two substances to enter into chemical combination. In the year 1839, Mr. Charles Goodyear discovered that raw rubber could be converted into a useful substance by mixing it with a certain amount of sulfur, and then heating this mixture under compression. Later it was found that the addition of litharge hastened the process of vulcanization and so this substance was recorded as an accelerator, or as we now term it, a catalyst—a carrier of sulfur, in this particular case. If rubber is properly vulcanized its physical properties of tensile strength and elasticity increase to a very marked degree. If a varnish has been properly "dried" we will note a similar change. For that reason I say that the problems of the one industry have much in common with the other.

And so we find that several mineral soaps—the oleates and stearates of lead and magnesium and calcium—have been applied successfully to the rubber-sulfur compound for hastening vulcanization. Aside from these we have the aluminum and zinc salts of oleic acid and stearic acid, and resin acids. These are more correctly classed as substitutes for rubber and one of the factors which determines their value for a given purpose is the so-called "volume cost." For example: lead oleate has a specific gravity of approximately 1.5; this means that one cubic foot weighs 94 pounds, whereas one cubic foot of water weighs not quite 63 pounds.

As the Investor Sees It

Let us consider the matter of national self-containedness. The United States today occupies a position unique among nations with regard to the supply of natural rubber. Just as the manufacture of dyes is the key industry for two other industries of far greater tonnage, the textile and paper industries, so rubber and cotton are at the present moment "key materials" for the rubber goods industry. Just as a single sample of this, no automobile tires are today made without rubber and cotton.

This question of key materials and key industries offers opportunities to the industrial chemist which few have appreciated. Cotton, as we know is a great American product, in fact we produce 60 per cent of all the cotton in the world. But it is only in recent years that we have attempted to plant, cultivate, and study the long-staple cottons. This is the work which our government has inaugurated in Arizona and the Imperial Valley of California. If you turn to rubber, you will find that high-tensile rubber is entirely absent as a natural resource. I say high-tensile rubber, because it is the tensile strength of rubber which counts.

Hevea rubber, which alone possesses this strength, grows almost exclusively in the East Indies and in the Amazon Valley. The distance from San Francisco to the Batavia is 8,000 miles, while the distance from Para to New York City is 3,000 miles. If you are a banker, an investor, a manufacturer of rubber goods, these are primary considerations.

The consumption of rubber in the United States in 1917 was 330,654,000 pounds. Our Government statistics show that we imported 5,100,000 pounds of Guayule rubber from Mexico in 1915, but beyond this, there was little or no rubber which grew on mainland adjoining the United States. It is for these reasons that the question of substitutes for rubber is of commercial and industrial interest to us. The question has been raised as to whether synthetic or factory-made rubber is of more importance than these substitutes. To this I would answer, that the substance which chemists call the rubber-hydrocarbon (the essential constituent of both the natural rubber and the rubber made from chemicals in the factory) possesses peculiar properties which have not thus far been duplicated in any other way. I have in mind the fact that real rubber gains in tensile strength and elasticity to an immense extent by the process of vulcanization. This is true of no other substance now known to us. But the *substitutes* for rubber have properties which rubber does not possess, and so these two groups of raw materials when combined yield a product far superior to that which we would obtain if each were used alone.

Asphaltum and petroleum pitches correct the porosity of some rubber compounds and so the product does not dry out, or harden so quickly; sulfurized oil, commonly called oil-substitute, acts as a lubricant for compounds used in the tubing machine in the manufacture of products like gas tubing. The glue-sulfonated oil compound is interesting because it is like the glue-glycerin compound—not affected by petroleum lubricating oils. On the other hand we have the water-insoluble soaps such as aluminum oleate which mix readily with petroleum or mineral oils, and form colloid solutions. Again, we have lead oleate, a metallic soap which has a distinct value as an *accelerator* in the vulcanizing process. Coal-tar pitch, alone, is of little value, but if it is combined with other products we obtain elastic substitutes for rubber which can be used in large proportions with natural rubber, to form useful commercial products.

And now, how much of these materials can be used in connection with rubber in the manufacture of commercial products? The answer is: from five to twenty pounds in a total batch of 100 pounds, and the amount used will depend upon the particular product which you are making. If you are a manufacturer of stationers' goods making artists' erasers you may possibly be using a compound consisting of 75 per cent oil substitute and a very small percentage of actual rubber. In certain products it is possible to use one pound of pitch hydrocarbon to every pound of rubber used. In fact these pitch products have until recently been sold under the name "mineral rubber" but today they are more frequently referred to as pitch hydrocarbons.

Another pertinent question is: How much of these substitutes have we at our immediate disposal? The nearest we can come to answering this is to state the figures for our annual production of glue, manufactured pitches, natural asphaltums, vegetable and animal oils—an amount fully as much as 330,000,000 pounds. Of course we can't use all of these for rubber, without giving up their present uses; but the amount given stands as a limit. According to the desperateness of any rubber famine that might arise, we could approach that limit.

As the Consumer Sees It

The one particular rubber product which comes into intimate contact with every citizen, is the gum shoe. Call it a rubber or golosh if you will, but the complaint is the same; the day a woman buys a gum-shoe she begins to wonder how long it will last. Then we have the city man who uses the garden hose on his lawn. He may be an optimist, and say that his hose lasts him five years,

(Continued on page 19)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Relief for Patentees

To the Editor of the SCIENTIFIC AMERICAN:

I beg to call to your attention, a matter of legislation which seems to be urgently needed as a matter of right and justice. Patents are granted for a term of 17 years and at the end of that term they become public property. They are granted upon the theory that the invention has benefited the public, because he has made something which is of utility to the public, or to use a figurative expression first employed by the Hon. James G. Blaine, he has made two blades of grass grow where one grew before. The theory of the patent law is that to encourage inventions of this kind, the inventor should be rewarded by the Government and this reward has been declared by Act of Congress, the exclusive right for 17 years. Before the Civil War, these patents could be extended, if the inventor could show that he had not been adequately remunerated for his invention owing to matters not within his control. That Act was repealed.

Circumstances of the present war seem to require that a similar law should be re-enacted For instance, I have a patent connected with the building art, and, as you know, building has been almost entirely suspended during the war and therefore, practically, four years of my patent protection has not been available through no fault of my own, and it is well understood that usually the last half dozen years of a patent are the best, because it takes a long time to educate the public to the knowledge of the merits of the invention, and in my case, this is particularly the truth. For it was years before I could get recognition of the merits of it in the building trade, and then in order to prevent imitators (or those persons I think more properly called "patent pirates") from infringing my invention, I was obliged to bring a law suit which has lasted a number of years and cost me a great deal of money and has recently been decided in my favor by the highest Court in this Circuit, that is the United States Circuit Court of Appeals.

This litigation has taken a large portion of the profits out of my term and then the war finishes the matter, so that my patent is nearly ready to expire without my really having received any reward for the benefits I have bestowed upon the public. I suggest, therefore, that a law should be passed, not to cover my particular case, but to cover all such cases—of which there are many. In other words, we should have a law based upon the principles of the former statute existing before the Civil War, which should provide for the application of any patentee for an extension of the term of his patent for say five years, upon a verified showing that the invention could not be adequately practised during the continuation of the four years' war just passed and that the patentee had, therefore, not received his just renumeration, which it was the object of the Statute to give him. I suggest five years so as to cover the period of the war, and the one year it would probably take to get the application before the Patent Office so that it would become effective.

I am suggesting that this legislation be limited to those inventions which have been damaged by the continuance of the war, because there are certain inventions related to matters involved in the war, which were benefited and stimulated rather than obstructed, and, therefore, the same reasoning does not apply to them. The previous statute relating to extensions had a somewhat similar limitation incorporated in it.

J. T. COWLES.

Chicago.

That Big Navy

To the Editor of the SCIENTIFIC AMERICAN:

Your article in the March 1st issue upon the Navy Program is illuminating. Few people have a true conception of the relative proportions of such enormous values as are involved. In these days of unprecedented expenditures a billion dollars conveys no more conception of quantity than a million used to in years past. Both are beyond the ordinary comprehension. Your article will do much to supply the needed perspective.

But there is another phase to the problem of equal importance to the expenditure of money which you did not mention. What will be the effect of diverting and locking up so vast a quantity of iron and steel into a product which cannot by any possibility be used to serve the material uses of mankind? Iron, from time immemorial has gone hand in hand with civilization, and has never been more needed than today for ministering to our thousand and one daily needs and comforts. I do not know what proportion of our total production of iron will be required to meet the unprecedented naval program, but it is by no means a negligible quantity. Will you not enlighten your readers in regard to this? The result must inevitably be an increase in the price of iron and steel with a corresponding increase in the cost of living and a consequent reduction in the supply of those commodities which minister to the needs and comforts of every individual in existence. For there is not a living soul who does not in some way utilize iron in his daily life.

It may be argued that the employment of labor would offset the increase in the cost of living. At first thought this might seem a plausible conclusion, but it is not so. In the ultimate analysis, the purposes to which man's labor is turned, determine the material prosperity of a race or a country. The employment of labor in the production of those commodities which minister to the needs and comforts of existence, governs the degree to which the material prosperity and comforts of the people in the country rise. The savage has little of these because his labor is employed exclusively in non-productive effort, in hunting and fighting. Civilized man has risen to a degree of comfort and enjoyment unknown to the savage through the application of his labor to productive uses, agriculture, clothing, travel and intercommunication as roads, mail, telegraph, printing, etc., and to the luxuries (legitimate ones), such as art, music and the millions of articles which administer to his needs and comforts. There is no such thing as an excess of labor. The trouble lies in its distribution. There must always be an excess of needs above the labor available to supply those needs, but it is unfortunately true that credit (wages), is so unequally distributed, that labor cannot be applied equitably to meet these needs.

A diversion, therefore, of an enormous amount of labor to an unproductive (in the sense of administering to the material needs and comforts of man) purpose while seemingly beneficial at the time, must needs be in the long run, a step backward, a retrogression toward savagery.

In presenting this viewpoint there is no thought of suggesting the idea of "pacifism," in its narrow sense, or unpreparedness—the magnificent service rendered by our Navy is of itself the answer to all argument. We need the Navy. But is the stupendous program now proposed a wise one at this time? Let every one give this matter his urgent thought.

HARRY D. TIEMANN.

Madison, Wis.

Using the Liberty Motor

To the Editor of the SCIENTIFIC AMERICAN:

Again and again I have heard the opinion expressed that the so-called "Liberty Motor" cannot be used other than for flying purposes during war times.

I can but disagree with your views as expressed in the issue of March 8th. These engines could easily be used in tractors and this by the simple expedient of removing the inlet rocker and providing—if necessary—a change in spring tension. In this manner the compression pressure, which is now too high for commercial service, can be made anything desired—say 40 pounds for "sweet" running.

The speed of revolution could be reduced by one-half for better service and wear—if a muffler or two mufflers are provided, the ensuing back pressure will help further to reduce the speed. And the carburetor will no doubt require new adjustment.

To "turn the sword into a plowshare" should become more than a mere platitude. Apply all "Liberty Motors" to tractors—it will be better that they wear out than rust out. If the powers that be still think the engine too large for such service, there would be the further expedient of removing one whole side of the engine; blanking the holes—then when the cylinders in use are worn out, the others are placed and the first removed.

Such an outfit would not be very economical in fuel, for the well known reason (to speak of the principal one) that an engine has good efficiency only over a narrow range of speed near its full load.

But what about that? The life of a tractor as expressed in acres plowed and depth cut is said to be very short indeed. The cost of fuel is not the deciding factor. Land is to be reclaimed for the soldier—here is the chance. Have discharged soldiers build a special tractor to receive the "Liberty Motor"—the Government then to employ the same men to plow the lands. The cost of the engines to be charged against this, not to exceed that of a conventional engine—the balance to be written off as cost of war.

P. G. TISMER.

Stapleton, N. Y.

The Freezing of Water Pipes

To the Editor of the SCIENTIFIC AMERICAN:

Referring to your answer in current issue to No. 14306, Notes and Querries, concerning the freezing and bursting of hot water pipes and hot radiators, I have often heard the explanation you give that the radiation is increased by having the air expelled from the water by boiling, but this explanation never seemed adequate to me.

It seems to me that the operations of *freezing* and *bursting* are usually confused. I cannot see how the hot water can well freeze or rather start to freeze first, as it must first lose its heat to reach freezing temperature. After that interval which is comparatively short, the freezing would proceed at nearly the same rate, though the hot water container would undoubtedly burst first.

Might not the explanation be that the air contained in the cold water being compressible allows a certain amount of expansion of the ice before putting a bursting pressure on the container? Also as the air does not freeze it would tend to segregate and provide a passage between the crystals for the escape of that portion still liquid. This is well illustrated by the freezing of alcohol or salt solutions. As the water crystalizes out the solution becomes more concentrated and does not freese at so low a temperature and so works out between the crystals without bursting the container.

You will note that to produce bursting there must be two stoppages with freezing between; a pipe can be frozen solid without bursting if frozen *progressively* from the closed end toward the open end.

While there may be some errors of reasoning in the above it has always seemed to me a more adequate explanation of the phenomenon under discussion.

J. M. DOCKSTADER.

Perth Amboy, N. J.

Power from Waste Water

To the Editor of the SCIENTIFIC AMERICAN:

In view of the fact that, in our present day life, people all over the world are groping about continually trying to create "cheap power," and as your magazine has already explained the use of ocean waves for creating power, I feel that I have an idea, which has not quite as great a field for power as the ocean, however, yet it is within much easier reach, and I feel quite sure that in time it will be used all over the world.

The idea is to allow all waste water from all buildings, large and small, to run through a water wheel before entering the sewer thus picking up at least half the power that was used in pumping it up. The argument against the scheme was that the water would be forced back into the wash bowls, etc., on each floor.

In my opinion this could be overcome by having a tank collect all the waste water, just above the water wheel, so that the wheel would be run from the weight of the water instead of from the force, thus creating no back action whatsoever.

While it is true that this power would not be regular, it is a fact that wind power is not regular either, and still it is put to a great many uses. Can you imagine the amount of power that could be obtained from a building like the Woolworth, Singer or any of the skyscrapers of New York City?

VICTOR A. SCHYE.

Bogota, N. J.

The Metric System and the Average Citizen

To the Editor of the SCIENTIFIC AMERICAN:

I want to mention one thing about the metric system that seems to have been overlooked, that may prevent its adoption in English speaking countries, so far as length measurements are concerned.

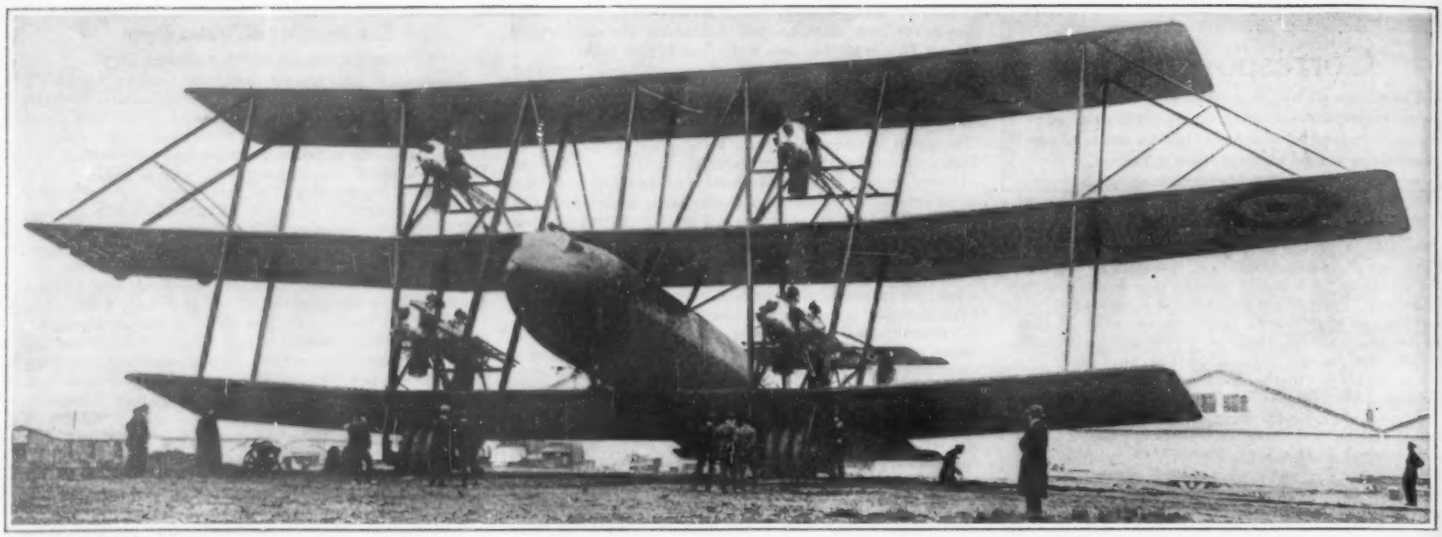
In the metric system everything has to go by tens, which is very convenient in calculations. But it has its drawbacks in every-day practice.

The unit of length measurement is the meter, which is 39.37 inches, a little over three feet or a yard. That of course is too large for every purpose, and so smaller denominations must also be used. The nearest measure under that is the decimeter, or one-tenth of a meter, a little less than four inches. This is very small for every-day use. Thus the only measures of length available for everyday use are the meter and the decimeter, the one a little over three feet the other a little under four inches.

This will be found very inconvenient in every-day use for English speaking peoples. They will miss the foot a great deal. As a substitute they may have to divide the meter into three parts, and make a sort of foot. For instance if one wants to speak of a man six feet tall they will have to say two meters. It will be the same with any other number of feet. Perhaps, however, they may resort to quarters and halves as they have in the case of the dollar. However they will miss the foot in every-day use.

A. Y. SMITH.

Louisville, Ky.



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General view of the first Tarrant triplane, the "Tabor", which came to an untimely end when attempting to take off on the first trial flight

Great Britain's Giant Bombing Plane

The Tarrant Triplane or the Story of a Bold Experiment in Airplane Construction

THERE is always something fascinating about the production of the greatest of anything. Curiously enough, most of the interest surrounding any particularly well-marked development stage in engineering in the past has been concerned with improvements in things connected with transport. Ships, bridges, docks, locomotives—all these adjuncts to the quicker and more convenient moving of humanity—have provided historical precedents, marking a definite step forward in mere size.

The coming of the airplane carried on the traditional interest, and the public imagination has been stirred from time to time as various giant airplanes and airships have taken the air and with their increasing weight, carrying capacity, reliability and range, revolutionized all our ideas on world distances.

And now the Tarrant triplane provides one more historic landmark in the growth of aircraft, the future of which rapidly vanishes from the sight of even the most gifted of prophets.

To survey the whole of the machine in its technical aspect would require a volume, and be very dry reading for all but enthusiastic designers with plenty of time to spare; but the following notes, taken from the excellent report of Lieutenant-Colonel Bristow, which appeared in a recent issue of *Aeronautics*, will give some idea of the chief features of the design and construction.

As will be seen from the brief specification further on, the machine has a total plane surface of approximately 5,000 square feet, and weighs with full normal load 45,000 pounds, although a higher loading is possible. The triplane form was adopted for several reasons, the principal one being the structural difficulty in designing so large a machine in the materials available otherwise than as a triplane; also the designer was of the opinion that the free flow of air over the center plane would compensate him to some degree for the aero-dynamic loss.

The machine is particularly remarkable, inasmuch as it is not only the largest airplane in the world, but some of the methods of construction employed are entirely new.

Chief interest will undoubtedly be shown in the fuselage. The lateral members are built of circular wooden girders braced on the Tarrant principle, which is covered by patents, and the longitudinal members are built into and through these rings. The whole forms what is practically a hollow girder, and its strength and permanence of form are entirely independent of any form of cross-bracing wires or other impedimenta. The whole is covered by a two-ply skin, which is built up of poplar slats fastened diagonally to the framework and glued together.

It is claimed that this form of construction is very much stronger for big machines, and that the fuselage being completely unrestricted internally will greatly facilitate the task of providing day and night accommodations for passengers, crew, goods, stores, etc.

A complete fuselage has been tested to destruction for load on the tail, etc., and a very high figure of load was reached before the deformation set in. Even then the disturbance was quite local, consisting of crinkling of the outer skin, but without distortion of the internal bracing hoops.

The main spars are also constructed on the patent girder principle, and form a very satisfactory feature of the structure, the ratio of strength to weight being very high.

The carrying-out of the destruction test on the fuselage, a big undertaking for a machine of this size, is indicative of the thorough manner in which the flying safety of the machine was, as far as possible, assured beforehand. In addition, complete wind tunnel tests for stability and control were carried out by the R. A. E. at Farnborough, England, with a model of the machine and parts, and the results were quite satisfactory. The ascertaining of the center of gravity is a difficult task on machines of this size, but this was determined by actual experiment, as only by this means could the safety of machines on their trial flights be assured. The subsequent alteration of the center of gravity within the limits allowable were corrected by adjustable empenage or tail planes in the usual satisfactory manner. A serious problem in the design was found in the landing chassis. The weight of the machine does not, of course, matter once it is off the ground; but the best means of landing a 20-ton structure at 50 miles an hour or so naturally requires very careful consideration. The makers, previous to the test of the first Tarrant triplane which ended in a wreck, were confident, however, that their arrangement, which followed normal lines, would be satisfactory, because the calculated load on tires, wheels, and shock absorbers was not in excess of those of smaller machines.

The provision of engines for the machine and their method of control has naturally been a difficult problem. The machine was originally designed to take four 600-horse-power engines, but six Napier engines were fitted instead, a total of, approximately, 3,000-horse-power. These were arranged in tandem, one pair above each of the bottom planes and one single engine on each side above the middle plane.

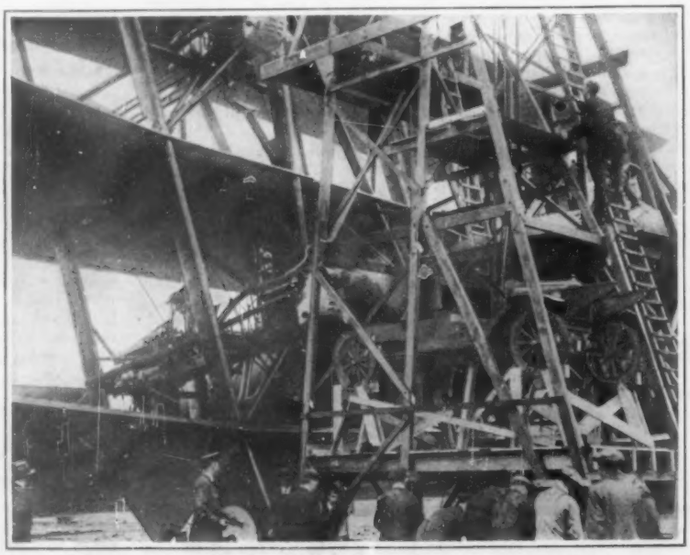
The matter of controls was, therefore, a difficult matter, but the system followed was unique and appeared to be quite satisfactory. At the back of the two pilots were two large control boards for the engineer officer. A wide space between the panels allowed free communication between pilots and engineer during flight. The pilot was provided with master throttles, engine speed indicators, and ignition switches, but the engineer took complete charge of cooling water temperatures, radiator shutter controls, carbureter altitude corrections, lubrication oil pressure, petrol feed pressures, and the minor non-flying controls, and, in addition, could start or stop any of the engines during flight as required.

The space alloted for these control boards and operator was most ample, and the general arrangement provided what is probably the best engine control room that has yet been designed for purely aeronautic duty. There were literally miles of piping, cables, wiring, etc.; but the whole arrangement bore every evidence of the most meticulous care in design and simplicity and strength in execution.

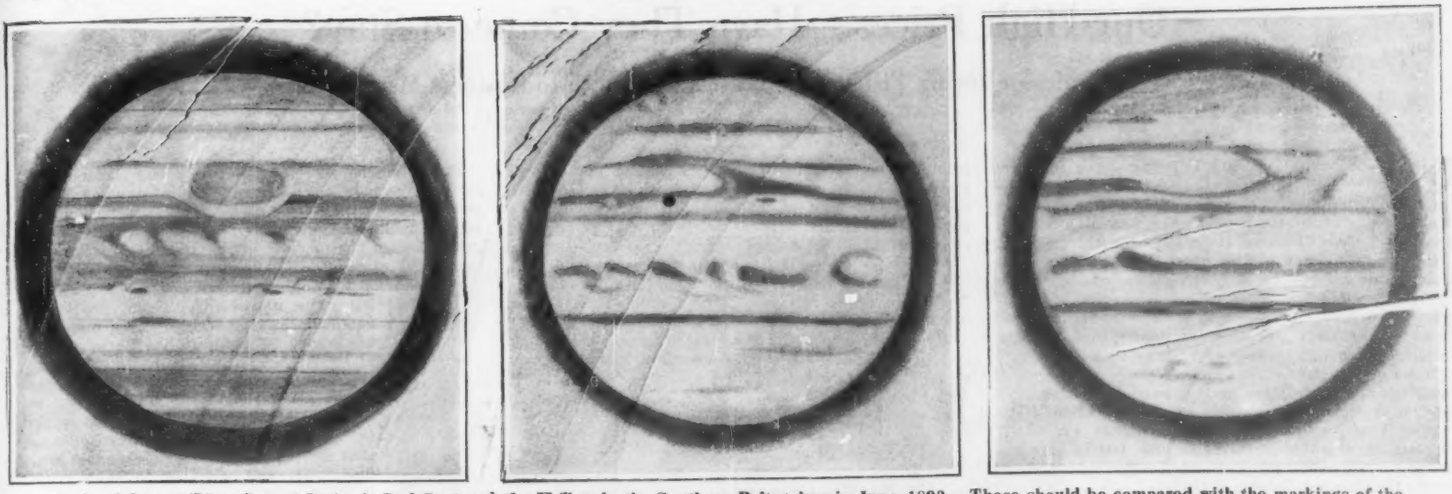
The idea for this giant triplane originated with Mr. W. G. Tarrant and Capt. P. T. Rawlings, D. S. C., R. A. F. Mr. Tarrant is well known for his extensive building and other engineering activities both in England and abroad, and is the inventor of the methods of wooden construction embodied in the machine. Indeed, there is no doubt that he has a remarkable facility for getting the very best out of every piece of timber with which he is constructing.

Captain Rawlings, at the outbreak of the war, obtained leave from his post as

(*Continued on page 20*)



Close-up view of the Tarrant triplane with a small automobile being used for hoisting purposes



At the right a striking view of Jupiter's Red Spot and the Hollow in the Southern Belt, taken in June, 1899. These should be compared with the markings of the planet as seen on December 19th, 1917; the center view was taken at 6.45 and the right hand one at 9.00, Greenwich Mean Time

Great Changes in the Planet Jupiter

By W. F. Denning, F. R. A. S.

CHANGES of aspect in the features visible on the disk of Jupiter frequently occur—in fact the details of his outer scenery as presented to us may be said to be constantly in process of variation. New markings appear, sometimes at incredibly short intervals, while others that may have been perceptible for weeks, months or years may quickly fade and suffer absolute effacement. Quite possibly there are recurrences of the same markings after periods of obscuration by the outer vaporous envelope of the planet. At any rate it is certain that similar spots return in the same zone of latitude, but these may be induced by phenomena operating from the surface below, which may occasion similar features according to the latitude of their distribution.

But whatever the alterations and transformations of Jovian forms may have been as observed in past years, it is doubtful whether any have been previously noticed of such considerable extent and important character as those which have recently taken place. The Bay or Hollow in the great southern belt, the Red Spot partly situated within that cavity, and a very extensive dark marking in about the same latitude called "the south tropical disturbance" have all recently disappeared or grown so extremely faint that they could not be discerned at the end of March, 1919. Yet the Red Spot had certainly been visible, under changeful aspects it is true, since Dawes first figured it in 1857; and the south tropical disturbance has been a conspicuous object since February, 1901. Every observer of Jupiter had become familiar with the Red Spot and its surroundings, and the obliteration of such prominent features will occasion both surprise and regret amongst planetary students.

To give an idea of the extent of the markings alluded to it may be said that the Red Spot was 25,000 miles long originally, while the south tropical disturbance has recently become so distended as to range over 180 degrees of longitude, or half the circumference of Jupiter—which corresponds, in the latitude in which it is situated (20-25 degrees south) to an actual length of about 125,000 miles.

We have no right to assume that the remarkable variations to which we have been referring apply to material formations or the actual surface of the planet. There is in fact almost conclusive evidence favoring the view that they are entirely of atmospheric character. The rotation period of the Red Spot and of the Hollow in the belt north of it has been variable and the rate has shown differences amounting to about 10 seconds. Considerable proper motion has often been exhibited by other markings and as deduced from a number of objects the rotation period of Jupiter might be anything from 9 hours 48 minutes to 9 hours 56½ minutes, that being the limit between the times given by features in different latitudes. Such changes of velocity as have been observed sufficiently prove that the objects are merely atmospheric and subject to vagaries of speed impressed upon them by the vicissitudes of an active vaporous envelope. The late N. E. Green and W. T. Lynn considered that the Red Spot constituted an integral portion of the actual surface of Jupiter, but it is impossible to conceive that this giant planet can display such erratic behavior in its rate of rotation as their conclusion requires. The Red Spot and other markings so abundantly and prominently visible are atmospheric or gaseous formations probably resulting from an active condition of the real surface. In the spring of 1860 a dark oblique spot appeared on Jupiter and within 64 days it distended so much in longitude as to form a new and complete dusky belt. In 1880, autumn and winter, a series of dark spots formed on the north temperate belt in latitude 25 degrees and these distributed themselves around the globe of Jupiter in 90 days. There appear to occur uprushes of material, perhaps of volcanic origin, from the surface of the planet; and the very swift rotary motion of his globe ultimately winds them into dusky encircling bands. Possibly both the dark belts and intervening bright zones are thus maintained by these reinforcements of dark and light material from the surface, which on reaching the outer layer of atmosphere are formed into the alternating bands which are the distinguishing aspect of the Jovian disk.

(Continued on page 20)

How the Meteorologist Aids the Aviator

THE exploration of the upper air by means of kites and balloons was inaugurated simultaneously in France, Germany and the United States about 1890. The primary object of investigation at that time was the elucidation of meteorological problems relating to the physics of the atmosphere. But it has been found that most of the data obtained are of great value in the new art of aerial navigation. In fact, the coördination between meteorology and aviation is now as intimate as that between astronomy and navigation.

Through the War, Navy and Post Office Departments the national government is encouraging the development of practical aviation. Through the Weather Bureau of the Department of Agriculture the necessary meteorological data are being made available. The Weather Bureau now maintains six completely equipped aerological stations where upper air investigations are carried on by means of kites and balloons. These stations are located at Broken Arrow, Okla.; Drexel, Neb.; Ellendale, N. D.; Brosbeck, Texas; Leesburg, Ga.; and Royal Center, Ind. Besides these there are

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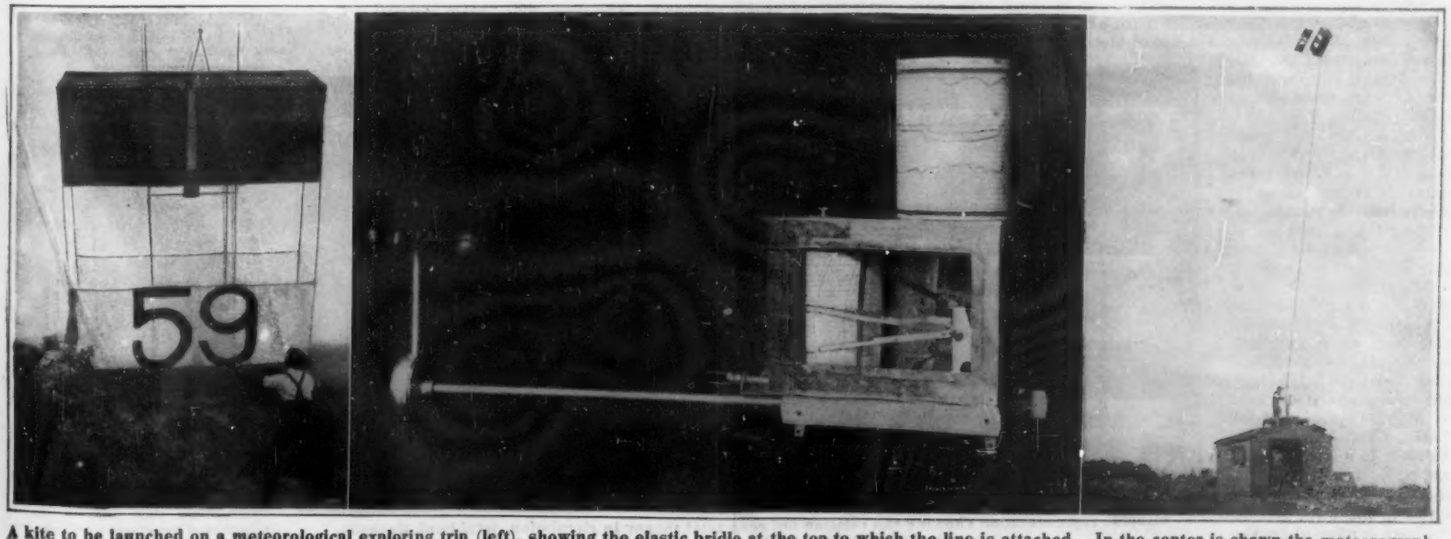


A kite to be launched on a meteorological exploring trip (left), showing the elastic bridle at the top to which the line is attached. In the center is shown the meteorograph that goes up in the kite and brings down records of wind velocity, humidity, temperature and pressure. At the right is seen the beginning of a flight

Our High Prices—Have They Come to Stay?

Professor Irving Fisher's Forecast and Advice to Business Men

By Alfred J. Lotka

BUSINESS conditions are determined in part by objective factors, such as the effect of weather upon the crops, the discovery of new gold fields, the existence of a state of war and the consequent upheaval in demand and supply along abnormal lines, and so forth.

On the other hand certain psychological factors have a large influence upon our economic system. Overconfidence and a somewhat exaggerated spirit of enterprise and activity are the invariable attendants of the upward movement preceding the sudden descent of a so-called economic crisis, just as despondency and collapse of confidence form part of the phenomenon of the crisis itself. In such cases it is usually difficult or impossible clearly to separate cause and effect. The psychological condition is no doubt partly caused by the existing objective state of affairs; but in turn the frame of mind of the people exerts a reflex influence and affects the objective factors of trade.

All this is perfectly natural. The purpose or function of our mind is to enable us to adapt ourselves to circumstances and to adapt the external world to our needs. Harm arises only when we proceed under mistaken impressions. That under certain conditions we should retrench in our constructive activities is sound business; where we are liable to err is in misjudging when conditions call for such retrenchment or when they justify expansion.

There are indications that our economic system is at the present time suffering more or less acutely from such misjudgment.

In many quarters production is held up, business is deferred, in the expectation that presently a fall in prices will offer more advantageous conditions for purchasing materials and labor; or, construction work is delayed out of solicitude lest a fall in prices should leave the investor with property on his hands which he will not be able to dispose of profitably. There is in many fields a willingness to sell but much hesitation in buying.

The fundamental cause seems to be largely psychological—the recollection of pre-war prices, and the tacit assumption that they represent in some obscure sense "normal" prices, towards which we shall ultimately revert.

Note that this conviction is not held without partiality. As Prof. Irving Fisher of Yale University points out, many manufacturers think that prices must come down, including the price of labor. But suggest to them that they make a beginning by lowering *their* prices, and immediately they are ready with a demonstration that *their* prices can not come down, and that *they* can not pay lower wages.

The fact is that in this latter contention they are probably substantially right. Where they are at fault is in supposing or maintaining that their case is peculiar. While here and there in special departments there may be fluctuations downward as well as upward, the present high tide in the general price level is probably due to fundamental causes which are not likely to be removed or materially altered in the near future, if at all. Professor Fisher, addressing a conference of Governors and Mayors assembled at the White House, expressed his view of the situation as follows:

"The fundamental practical question confronting business men is whether the general level of prices is going to fall. In my opinion it is not going to fall much, if at all. We are on a *permanently* higher price level, and the sooner the business men of the country take this view and adjust themselves to it, the sooner will they save themselves and the nation from the misfortune which will come if we persist in our present false hopes."

In order to understand the situation it is necessary to form a definite idea regarding the way in which the general price level is affected by the total amount of currency that is in circulation. It will assist us in gaining an understanding of this matter if we consider first of all an ideal simple case. We can afterwards fill in the details corresponding more closely to actual conditions.

The simple case which we shall first consider is that of a community in which all payments are made in one kind of currency, say gold, and in which there are no credit transactions.

In order to deal in round numbers, let us suppose that in this community there are in circulation 50,000 ounces of gold which in our coinage represent about one million dollars.

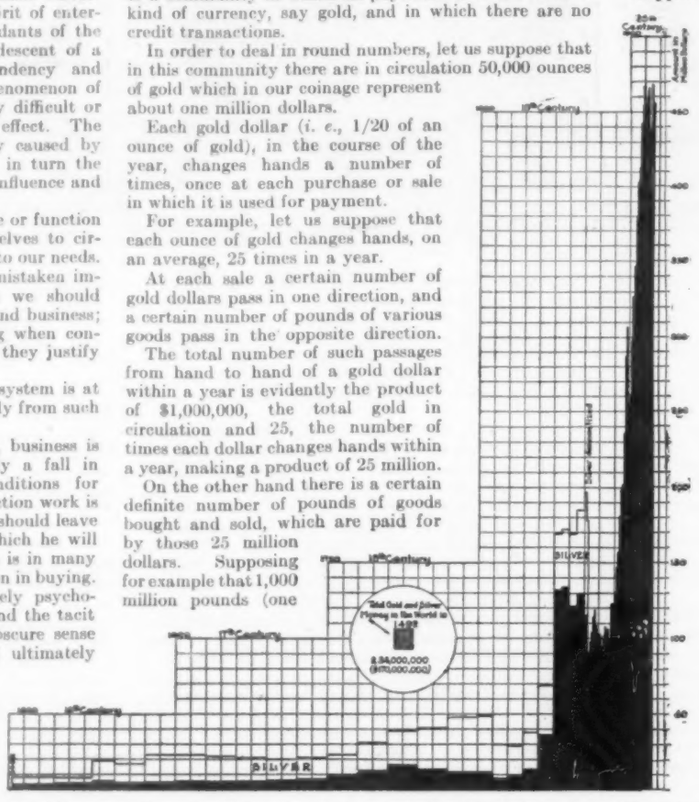
Each gold dollar (*i. e.*, 1/20 of an ounce of gold), in the course of the year, changes hands a number of times, once at each purchase or sale in which it is used for payment.

For example, let us suppose that each ounce of gold changes hands, on an average, 25 times in a year.

At each sale a certain number of gold dollars pass in one direction, and a certain number of pounds of various goods pass in the opposite direction.

The total number of such passages from hand to hand of a gold dollar within a year is evidently the product of $1,000,000, the total gold in circulation and 25, the number of times each dollar changes hands within a year, making a product of 25 million.

On the other hand there is a certain definite number of pounds of goods bought and sold, which are paid for by those 25 million dollars. Supposing for example that 1,000 million pounds (one billion pounds) of goods change hands in the course of the year, then the average price per pound will be 25/1,000 of a dollar, or 2½ cents.



World's production of gold from the discovery of America to the close of the year 1918, also production of silver until demonetized in 1873

Now suppose that all other conditions remain unchanged, but that by some means or other we are able to just double the amount of gold in circulation. In these new circumstances 50 million dollars will pay for the same 1,000 million pounds of goods. The price per pound, on an average, will now be five cents, just twice what it was before.

It will be seen, therefore, that, if in such a community as we have been considering, the total amount of currency in circulation is increased, while other conditions remain unchanged, the effect is to raise all prices in the proportion of the increase in the amount of circulating medium of exchange.

Suppose that the doubling of the gold dollars is carried out quite impartially. Each man would suddenly have twice as much money in his pocket as before. At the same time all prices would be doubled. Evidently this would make absolutely no difference in the general economic status of the individual in the community. It is only if the readjustment takes place unevenly that the change causes more or less acute discomfort and suffering to some, while it brings profit to others. In point of fact this is always the case in actual practice, owing to the effect of long time contracts and the inertia of law and custom.

In practice, of course, it will never happen that a change in the amount of currency in circulation takes place unaccompanied by other changes in various economic factors. But the effect of the change in the amount of currency in circulation will be essentially the same, though the influence of other factors (such as an increase or decrease in production of commodities) may be superimposed upon that of the change in circulating medium, so as either to reinforce its effect or to mask it more or less completely.

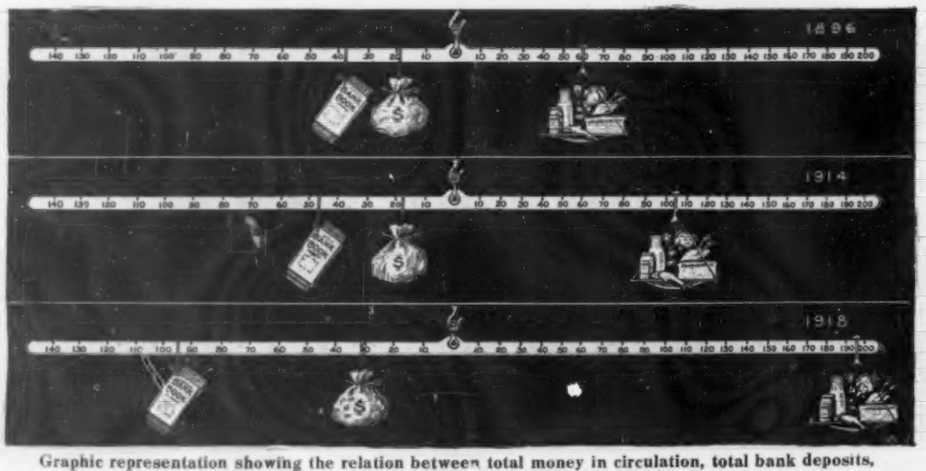
Now in a modern community there are other things aside from gold that function as a medium of exchange. Coins made from other metals do not materially affect the argument, so far as the United States is concerned, because their total value is but a small fraction of that of the gold in circulation, and their issue and exchange value is fixed by law in terms of gold.

The situation is very different in the case of certain forms of paper currency. Since 1914 Federal Reserve Notes and National Bank Notes amounting in the aggregate to a large value have been issued, which are but partially covered by gold. That portion of the paper currency thus issued, which is not covered by gold, represents so much increase in our total money in circulation.*

Another factor which exerts a very important influence on the purchasing power of the gold dollar is the habit or custom established to a greater or less extent in modern civilized countries, and in particular in our United States, of carrying bank deposits subject to check. Such desposits, formed in part of promissory notes secured by various forms of a non-negotiable property, virtually convert such property into liquid, circulating currency. Using again the words of Prof. Irving Fisher:

"To put it crudely, banking is a device for coining into dollars land, stoves, and other wealth not generally exchangeable."

The effect of an increasing prevalence of payment by check is very much the same as if the amount of gold in circulation were increased: Taken by itself, that is to say, in the absence of any compensating changes, it is bound to produce a rise in the general price level. Similar remarks apply to the practice of trading on the basis of book credit, since this tends to create offsetting



Graphic representation showing the relation between total money in circulation, total bank deposits, velocity of circulation, total trade, and general price level

*The recent issue of Federal Reserve Bank Notes does not represent any expansion of our currency, since they were merely substituted for silver certificates which were retired.

debts, which can be partially cancelled without money changing hands. This again is virtually equivalent to the effect of increasing the amount of money in circulation and tends to bring about a rise in the general price level.

The relation between the principal factors thus affecting the general price level is shown graphically in one of our illustrations.

The upper one of the three diagrams represents conditions in 1896. The money in circulation at that time was 88 billion dollars, its velocity of circulation 18.8—that is to say, each dollar changed hands 18.8 times in a year. This fact is represented in the drawing by a money bag suspended from the scale arm at a point corresponding to 18.8.

Similarly a bankbook suspended at a point 36.6 indicates that in 1896, 2.71 billion dollars of bank deposits circulated with a velocity of 36.6 per annum for each dollar.

These two factors are balanced on the right hand side of the scale by a certain quantity of all kinds of goods, multiplied by the lever arm, which here represents the price per unit, expressed in percentages of the 1909 prices. It will be understood that the ordinary principles of the lever are assumed; the leverage equals weight multiplied by distance, and is equal on both sides. The diagrams for 1914 and 1918 are similarly drawn, but the corresponding figures here are:

	1914	1918
Currency in circulation	1.94*	2.46
Velocity of circulation	17	30
Bank deposits	8.89*	12.5
Velocity of circulation	46.8	95.6
General price level, expressed in per centages of that in 1919	104	198

*In billions of dollars.

How does all this apply to the present conditions in the United States?

Over one billion dollars in gold has come into this country from abroad since 1914. On June 30th, 1918, the portion of the gold reserve of the Federal Reserve banking system which supported national bank deposits and Federal reserve notes was three times as large as the gold reserves under the old national banking system on June 30th, 1914. During the same period credit instruments (demand deposits and notes) increased about twofold. There is at present a surplus of about 700 million dollars over the legally required gold reserves, and on a conservative estimate this would be sufficient to support a future expansion of 50 per cent in our credit instruments.

These factors in themselves go a long way to account for the present high prices, and do not point toward any probable fall of level.

Such a fall might be induced or aided by a return of gold from reserves into circulation. But experience elsewhere and in the past makes such return appear extremely improbable; the habit of carrying gold currency has lost ground both in our Western states and also in the United Kingdom.

Another factor which would tend to lower our price level would be the outflow of gold to Europe and to other countries. But we are now the creditors of Europe, and money will flow towards us rather than out of our borders. Nor can we figure with any degree of confidence on the introduction of low-priced goods from Europe when normal trade is reëstablished, and look for a corresponding outflow of gold. For prices have risen to even higher levels in Europe than they have here.

These horses had never worked tandem before, yet in ten minutes they were performing perfectly

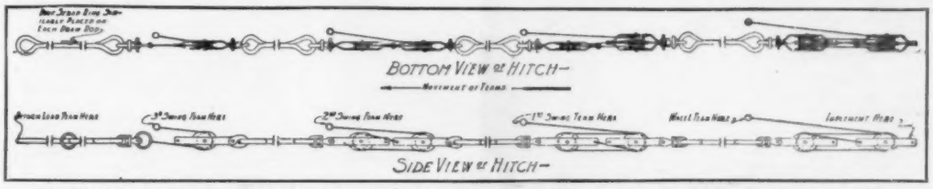
The reconstruction and rehabilitation of devasted regions will call for loan issues and for extension of bank credits. Our Liberty bonds furnish unrivaled security for further borrowings from banks for commercial purposes, and will continue to exert their credit-expanding effect until redeemed by the Government.

Any attempt to reduce bank credit will meet with strenuous opposition. The hostile attitude of labor toward lowering of wages will deter legislators and bankers from any organized policy of contraction.

Most important of all, perhaps, will be the effect of expanding credit in Europe and elsewhere outside our boundaries. The needs of the war have taught the countries of Europe the uses of deposit banking. In China and India also the system is growing. The result will be much the same as if a new source of gold had been found.

The net conclusion seems to stand out clear: All indications are that we may look for little if any fall in the general price level in the near future; that on the contrary we may expect a rise to continue for a considerable time to come. To sum up in the words of Professor Fisher:

"We are on a new price level, which will be found a stubborn reality. Business men are going to find out that the clever man is not the man who waits, but the one who finds out the new price facts and acts accordingly."



The hitch that takes the plod out of plowing, by making it possible to use effectively almost any number of horses, in tandem team formation

Taking the Plod Out of Plowing

By C. E. Gapen

As man's first assistant the horse has naturally been the subject of numerous investigations and experiments. We have studied his family connections clear back to the time when he had a number of toes and was about the size of a tomcat; but until recently very little progress had been made in studying the connection between the horse and the plow and various other farm implements.

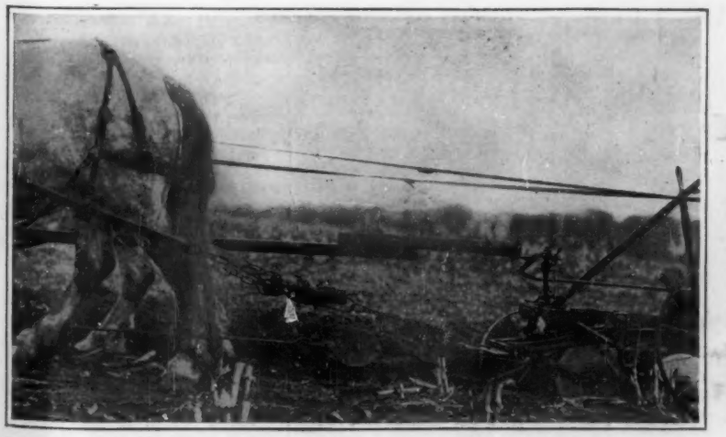
The machines have been improved rapidly and the horse himself has been developed to the drafter that tips the scales at more than a ton; but the ways of applying the power of the improved horse to the improved machine have remained much the same. However the last two years have seen some developments that should mark an epoch in the application of animal power to farm operations.

In the fall of 1917 Mr. Wayne Dinsmore, secretary of The Percheron Society of America, the largest horse recording association in the country, made some investigations that proved to his satisfaction that a large percentage of the farmers in the United States were not getting enough work done per man nor per horse. He found that New England farmers were plowing one acre a day on the average, Ohio and Pennsylvania farmers from two to two and a half acres, Illinois and Iowa farmers from four to five and a half, and the farmers in the big wheat-growing regions of Oregon and Idaho eight and a half acres a day per man. For this gradual improvement in results from East to West, the explanation may be found almost entirely in the number of horses worked by one man and in the hitches used.

The result of this looking around has been a development of hitching appliances that should have a remarkable effect on the future of the heavy horse. The Percheron Society prevailed upon the University of Illinois to try out experimentally different sized teams and various ways of hitching them to farm implements, and last year Prof. E. A. White of the Farm Mechanics Department made thorough tests of all known hitches and of some that had not been known before.

It has been customary when four horses or more were worked together on a plow to hitch them abreast, and because they had to be kept off the plowed ground the team was thrown over to one side creating what is known as "side draft." The side draft when four horses are hitched abreast to a plow averages about 25 per cent. And side draft is all waste. It is pull exerted in another direction from that in which the implement is supposed

(Continued on page 22)

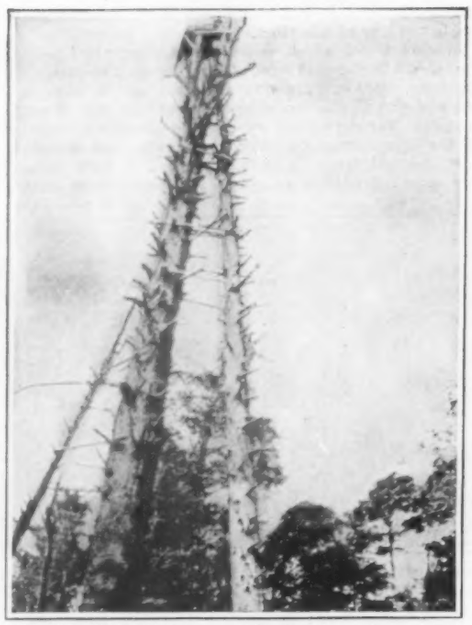


Two single pulleys used when one team is pulling against two. The pulleys are light; there is no need for weights to regulate the angle of traces to the wheelers

The single pulley used when one team pulls against only one ahead. Here the pulley must be heavy, to keep the traces at the right angle with the shoulders

The Natural Triangulation Station

NOT so long ago we showed how the lumbermen of the great Northwest sometimes take advantage of the position of a tall tree to relieve themselves of the necessity of erecting a derrick mast. The lumbermen are not the only ones who know how to take advantage of the facilities offered by nature, as the photograph reproduced on this page shows. When the Coast and Geodetic Survey found the two immense trunks of this picture in the position shown, they jumped at the chance to set up a triangulation station on this unique tower. Some idea of the size of these fallen—or perhaps we should say falling—giants of the forest, and of the elevation which the surveyors attain from their summits, may be got by looking for the man who is climbing to the platform. Yes, there is a man in the picture, climbing the right-hand tree. After you have found him, you may guess how high the platform is from the ground.



How the Geodetic Survey took advantage of a natural vantage point in erecting a triangulation station

What Do Rings Around the Sun Signify?

RINGS around the sun or the moon are properly called halos. They may be defined as somewhat complicated arrangements of arcs and circles of light surrounding the sun or the moon accompanied by others tangent to or intersecting them, with spots of special brightness called parhelia appearing at the points of tangency and intersection. Parhelia are most often observed about sunrise or sunset, frequently when the intersecting arcs are themselves invisible, except at the points of intersection. In order of frequency, halos average about 22 degrees, 46 degrees, or 90 degrees in radius, but on rare occasions other sizes have been observed.

Halos are observed only when there is present in the higher atmosphere a cloud sheet which meteorologists term cirro-stratus. The floating moisture particles forming this cloud sheet are ice crystals, as the cloud is always above the plane of permanent freezing temperatures. These are the highest clouds known, the average height being five to six miles. When the sun or the moon is observed through such a cloud sheet, refraction and reflection of some of the sun's rays by the ice crystals produce rings in which the colors, when visible, are invariably arranged with the red on the inside of the arcs.

Halos are good weather signs. Many weather proverbs based upon the observation of halos are founded upon sound scientific principles. Studies of the relation of halos to rainfall show that during the summer months 50 to 60 per cent of all halos are followed by rain within 36 hours. During the winter months 70 to 75 per cent are so followed. Precipitation follows sooner in winter than in summer because storms move more rapidly then.

Figure 1 is a drawing of an unusually conspicuous solar halo observed in Arkansas in 1913. Ordinarily all that can be seen is either one or both of the two concentric circles, with brightly colored "sun-dogs," one on each side of the sun. Figure 2 is a longitudinal section through a typical storm as it moves across the United States from west to east. This is the region marked "Low" on the daily weather map published by the U. S. Weather Bureau. In this longitudinal section there are indicated by means of arrows the region of the storm in which the halos are usually observed.

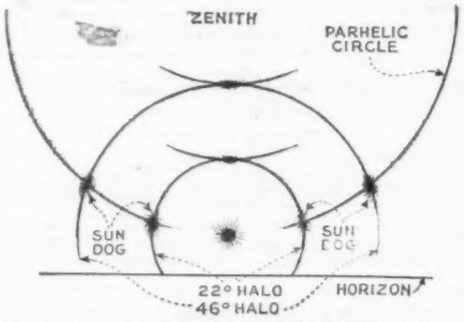


Fig. 1. An unusually extensive halo that appeared in Arkansas in 1912

Painting with a Jet of Air

THE modern method of applying various kinds of paints and other protective coatings is by the use of compressed air. This is rapidly superseding the old hand-brushing method, not only by reason of the great saving in time and labor, but also due to the fact that better results are obtained.

There is hardly a comparison between pneumatic painting and the old-style way. One handy workman, for instance, can do the work of three to twelve or more skilled painters using hand brushes, depending upon the nature of the work. Uniformly finished coatings free from streaks and brush marks are produced. Rough, irregular surfaces and those inaccessible or difficult to reach with a brush are readily coated. Where single coat work is required, either a lighter or heavier coating can be obtained than is possible with hand brushes. The gun, for such is the usual name of the pneumatic painting device, may be quickly mounted on an extension pole attachment for painting surfaces beyond the reach of the operator. The air-tight material container prevents the formation of paint skins, and makes it impossible to combine dirt with the paint. These are but a few of the leading advantages of the pneumatic system of painting.

Pneumatic painting equipment consists of a container; a flexible, metal-lined hose; a heavy rubber air hose; and the paint gun or nozzle member. Some materials require continuous agitation in order to keep the heavier parts in suspension, and for this purpose an agitating attachment is employed. This device is screwed into the main air port in the bottom of the control head. The agitating is done by air, which, after passing through this attachment and bubbling up through the paint, is allowed to escape through the bleeder valve in the control head. When using certain varnishes and enamels, on the other hand, it has been found that, in order to obtain the best results, the air should be heated before it reaches the gun. If this is done and the material is also heated before being placed in the material container, a perfectly smooth coating can be obtained. For this purpose an electric heating attachment is sometimes used with a pneumatic painting equipment. This attachment may be operated from any ordinary electric light socket. It is so designed that it may be turned on at the same time as the gun trigger is pulled by the natural grip of the hand.

Compressed air for the paint gun is generally supplied by a compressor unit which may serve several paint guns at one time.

Today paint guns are employed to a very wide extent. In many industrial establishments they are employed for all kinds of painting. In the production of explosive shells during our participation in the world war, the old inefficient method of applying protective coatings by dipping, pouring, and swabbing, was dropped in favor of pneumatic painting.

Waste of Chemicals in Pulping

IN the manufacture of sulfite and mechanical pulp, all bark must be removed from the wood before chipping or grinding since any fragment of bark finding its way into the pulp makes its appearance as minute black specks in the finished sheet. For soda or sulfate pulp, the cleaning is often not so thorough, since the alkaline digestion tends to destroy the bark. Some mills bark the wood partly or not at all in the manufacture of sulfate pulp.

To determine the amount of chemical required to pulp unbarked wood, shipments of unbarked shortleaf yellow pine chips and of clear bark were tested by the Forest Products Laboratory of the U. S. Forest Service, at Madison, Wis. The results indicate that in pulping a ton of wood (bone dry), consisting of 96 per cent wood and four per cent bark, 22.9 pounds of caustic soda and 8.5 pounds of sodium sulfite are needed to reduce the bark. The pulp produced from the bark is useless and, furthermore, produces a variation in color of the pulp, which makes it difficult to maintain a uniform shade in the finished paper.

Gluing Veneer at High Moisture

IT is common practice among plywood manufacturers to dry veneer down to very low moisture content before gluing it. The object in doing so apparently is to prevent shrinkage of the veneer and consequent marring of the appearance of the finished panel. The drying is done in plate redriers, textile driers or similar apparatus, and adds appreciably to the cost of manufacturing panels.

That such preliminary drying may not be necessary is indicated by the results of a recent investigation by the Forest Products Laboratory. Veneer panels were glued with casein glue at various high moisture content (some over 50 per cent) and in various tests proved as strong and as desirable as those made under drier conditions. In fact, in the moisture resistance tests a considerable proportion of the veneer which had been dried before gluing showed signs of failure, whereas veneer glued at a moisture content of 15 per cent or higher gave practically perfect results. Panels made at high moisture content checked if dried too rapidly, but this difficulty could be avoided by proper operation of the kiln.

It seems possible, therefore, that the cost of producing panels of certain kinds may be very materially lessened through the use of water resistant glue and the reduction or even elimination of preliminary drying. Very dry veneer is more likely to break or split than damp veneer; an additional saving is therefore possible through a reduction of waste.

The use of moist veneer, of course, is not practicable for some purposes, but it is quite certain that much of the veneer which is now being painstakingly dried before gluing might advantageously be glued at a higher moisture content.

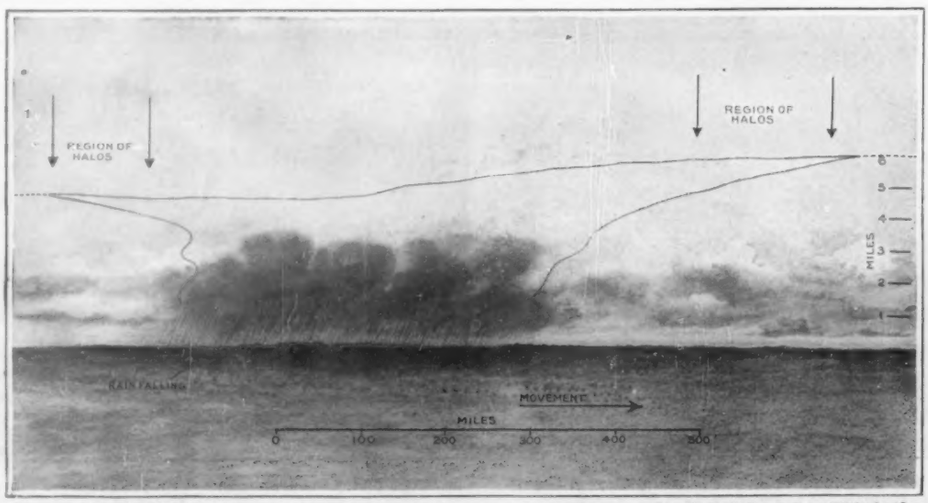


Fig. 2. Longitudinal section of a typical storm as it moves eastward across the United States. This is the region marked "LOW" on the Weather Bureau's daily map

Watching the Growing Seed

IT has always been rather a difficult matter to watch the development of a seed in a normal manner. To take up the little plant at intervals to see how it is getting on results in a very unnatural growth. The following simple plan has been devised by a demonstrator. An ordinary glass jar is lined with thick paper of a somewhat light tint. The interior of the jar is then filled with damp sand or sawdust. This material is kept in a moist state. The seeds to be observed are pushed down in between the paper and jar as shown in the photograph. A brown paper bag or other covering of dark material is employed to keep away the light from the outside of the jar. The damp from the sawdust or sand soaks freely through the paper in the jar, and the seeds secure all the moisture needful for their development At all stages they can be freely examined without disturbing them in any way, and thus an excellent idea of the manner of growth under nearly normal conditions is obtained.

Seeds "planted" in glass jar so as to be accessible for observation

Let the Water Dog Chase the Mosquitoes

HAVE you a water dog? Some years hence the water dog may be considered a more necessary acquisition to the home—especially the summer home—than the bull pup or shepherd collie. The western newt, or water dog as it is most commonly known, delights in eating up all of the mosquito larvae around the ponds and rain barrels and will if given a free hand devour all the young mosquitoes in sight. This is not fancy, but the result of very careful investigations recently announced by A. C. Chandler of the Oregon Agricultural College.

Anyone who has been troubled with mosquitoes buzzing about him at night and has found the unscreened porch a very uncomfortable place to spend the cool of the evening realizes what mosquito control means. Some mosquitoes are known as carriers of malaria and yellow fever. Naturally many plans have been proposed to get rid of them. One successful plan has been to drain all the marshes and ponds. This is sometimes almost out of the question and then, too, mosquitoes will lay their eggs in rain barrels and other places. Another plan is to spray the ponds with kerosene and other preparations. This is expensive and laborious, and these applications must be repeated at intervals throughout the season. Up to this time, however, practically no use has been made of the natural enemies of mosquitoes, with the exception perhaps of a few fishes, such as minnows, and many mosquito breeding places will not admit of fish living in them. Applications of kerosene to the water to kill mosquito larvae at the same time make it an unbearable place for the natural enemies of mosquitoes, and so things may be worse off than before, unless the applications are continually repeated.

So workers at the Oregon Agricultural College hit upon the western newt or water dog, found in large numbers in that section of the country. The newt is a member of the salamander family, and is closely related to the spotted newt found in the East. Full-grown male water dogs may reach a length of eight inches, while the females may be five inches long. This particular salamander is found especially on the western coast, where the climate is not too rigorous. Most of the year the adults live in the water, but in the fall they may crawl about in the dead leaves.

One of the remarkable features about the water dog, according to Professor Chandler, is the fact that it is practically immune to natural enemies itself, which is not the case with minnows and other fish which could be turned loose on the mosquito larvae. Generally snakes will not even molest the water dog.

It was first noticed that three pools of water near Corvallis, Ore., never were inhabited by mosquito larvae, but on the other hand were well supplied with water dogs. But not far away pools of water were swarming with mosquito larvae, and here there were no water dogs.

The water dog, and a sample of the potentially ideal breeding places for mosquitoes which he keeps free of the larvae

A careful survey was made of numerous ponds in the vicinity of the college throughout the summer and no mosquito larvae were found where the pools were inhabited by water dogs, although they appeared to be ideal breeding places for mosquitoes.

Some laboratory experiments were carried on and it was found that a single water dog would devour as many as 200 mosquito larvae in 24 hours, besides killing a great many more. One water dog was found to have destroyed 400 larvae and pupae (young mosquitoes) in 24 hours. But it was also found that water dogs can go for weeks and even months without appreciable food.

In another experiment two water barrels were stocked with between 800 and 1,000 mosquito larvae each. In one of the barrels two water dogs were placed. This was on September 5th. The larvae and pupae developed rapidly. On September 12th there were no larvae or pupae to be found in the barrel guarded by the water dogs, while the other barrel swarmed with mosquitoes.

Experts from the Oregon Agricultural College have suggested the use of water dogs in rain barrels, water troughs and the like. The barrels naturally should be free of tar or such artificial substances, although the salamanders will live in any water not too filthy. The water dogs do not injure the water in any way. Around farm houses water troughs are principal breeding places of mosquitoes and here the dog would come in handy.

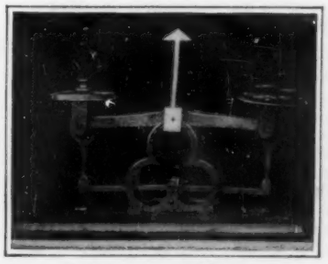
If swamps and marshes cannot be drained, the water dog apparently will prove more efficient and cheaper than oiling. About one water dog for each 10 yards would be sufficient. Reservoirs, mill ponds, etc., can thus be kept free of mosquitoes. In North Berkeley, Cal., water dogs breed in enormous numbers in a reservoir and no mosquito larvae are ever to be found there. Irrigation ditches where the water is sluggish are another place where the salamanders will thrive and aid in abating the mosquito nuisance.

Visible Weighing

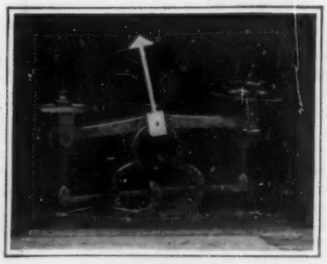
WE illustrate two applications of a very neat and interesting apparatus for making apparent to the eye small variations in weight.

The device consists merely of a cardboard pointer fastened in an exact perpendicular relation to the bar of an ordinary balance. The substance to be weighed—ordinarily an efflorescent or deliquescent compound or organism—is placed upon the pan, and balanced with weights. The pointer will then take an exactly vertical position. At the conclusion of the interval over which the test is to extend, the object is again placed upon the scales, which have not been disturbed in the meantime. It will now, however, be either too heavy or too light to balance the weights; and the resulting deviation of the pointer from the vertical affords a ready graphical indication of the loss or gain in weight.

The testing of seeds for absorption or evaporation, and the determination of whether a plant is transpiring, which form the subjects of our illustrations, are merely suggestions as to the scope of this procedure. Obviously the device might be put to a very large variety of uses.



Half an ounce of beans



After drying they are lighter

Balancing a plant upon the scales for a preliminary weighing

Two hours later—a graphical measure of the moisture given off

Records of Body Temperature

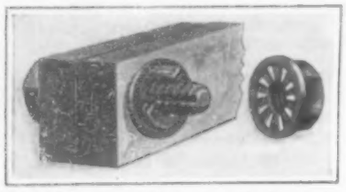
AT the Royal Society conversazione of May 28th, Drs. G. Sims Woodhead and Varrier Jones exhibited clinical apparatus for making quasi-continuous records of temperature, and specimens of records. The outfit, as described in *Nature*, consists of a resistance thermometer with compensating leads, a galvanometer with "bridge" and resistances, by means of which a wide range of temperature changes may be observed, and a Cambridge thread recorder, which gives a record (at half-minute intervals) of the temperature of the human or animal body. This apparatus has been used to determine the diurnal variations of temperature of normal subjects and also in studying febrile conditions in disease. Continuous temperature records for 72 hours are easily obtained.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Another Idea in Lock Nuts

IF a list were prepared of the most prolific sources of ideas and inventions, the lock nut would certainly be included—and among the first dozen. Indeed, the lock nut problem has been a sort of classic with inventors; and there have been no end of good ideas on how to make a nut lock hard and fast, together with the inevitable proportion of suggestions which are not so good.



One of the latest ideas for a lock nut, in this case based on the ratchet principle

In the accompanying drawing is presented still another lock nut design, in this case the invention of Mr. Louis Frenot of Newark, N. J., who has devoted something like twenty years of his life to the lock nut problem. In the present design, however, Mr. Frenot believes he has solved the problem of a simple nut that locks and is proof against any degree of vibration. The fact that some of his lock nuts installed on main line switches of leading railroads have had over a year's service without the slightest "give," seems fully to warrant his belief that he has supplied a lock nut which will lock.

As will be noted in the drawing, Mr. Frenot's lock nut consists of a nut proper, having one side cast with radial grooves and ribs, a spring washer member with two dogs which engage with the radial grooves so as to form a ratchet arrangement, and a bolt. The spring washer member is provided with a central projection or key which engages with the keyway of the bolt. When assembled, the dogs engage with the radial grooves as the nut is driven home, the ratchet hold increasing with each turn of the nut. To remove the nut, a wrench must be employed until the ratchet pressure is sufficiently lessened to be overcome by hand turning.

A Dinner Pail Which Includes a Stove

AFTER all is said and done, there is nothing like a hot meal in satisfying one's hunger, especially in cold weather. So, working on the theory that the workman's dinnerpail would be far more efficient if it made some provision for warming the food, Whitelaw R. Wright of Marion, Ind., set to work some time ago and succeeded in evolving the self-heating dinnerpail which is the subject of the accompanying illustration.

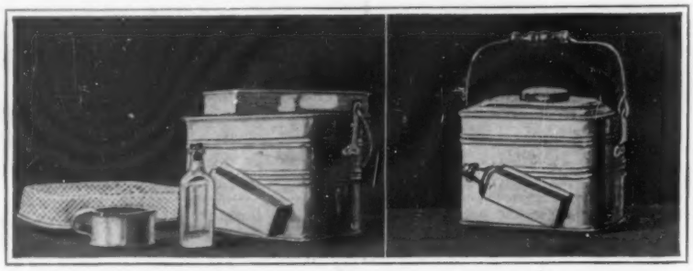
There is nothing radically different about the dinnerpail of Mr. Wright, at least as far as the general design is concerned. Starting with a standard dinnerpail as a basis this inventor has merely altered the design of the usual lid so that it includes a burner arrangement, while the side of the pail has a holder for a bottle of alcohol. To operate this pail the cup is removed from the lid, and the lid is removed from the pail and inverted. One tablespoonful of denatured alcohol is poured into the holder, ignited, and laced under the dinnerpail. A groove in the bottom of the pail engages with the edge of the perforated wall of the lid, so that the improvised stove forms a fairly rigid unit. In five minutes a pint and a half of liquid will be heated to the proper degree.

The bottle contains a week's supply of alcohol. This fuel, of course, burns without smoke or soot; and the flame, being confined within the perforated enclosure, cannot be blown out by moderate winds. The tray is in addition to the pail, and with its use the capacity is increased and the lunch can be warmed considerably faster, if desired. The self-heated pail, according to the inventor, costs but a trifle more than the standard dinner pail.

Tamping Concrete with an Unbalanced Gasoline Engine

VIBRATION is generally a menace with most machinery; but occasionally vibration is deliberately created and utilized for odd purposes. Such is the case with the concrete tampers shown in the accompanying view and used for tamping concrete roads and floors.

Thus there has been worked out an ingenious and labor-saving method of tamping newly poured concrete, by means of vibration. As will be noted in the illustration, the tamper in this case consists of a motorcycle engine mounted on heavy rollers. The engine is unbalanced so that intense vibration is set up and communicated to the heavy rollers. The procedure in this case is to lay boards on the newly poured concrete, and then wheel the vibrating rollers back and forth over the boards. In this manner the concrete is thoroughly and evenly tamped, in a minimum of time, and at minimum expense.



A tablespoonful of alcohol ensures a hot meal when the workman is provided with this patented self-heating dinner pail

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Using unbalanced motorcycle engines for tamping newly-poured concrete is one of the latest tricks in modern road building

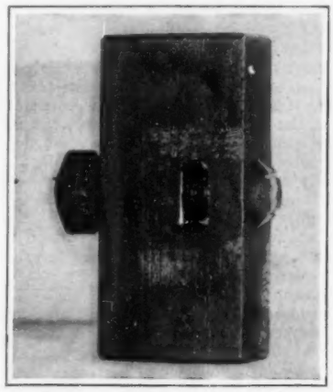
Investigating the Tool Holder

ANYBODY might be pardoned for supposing that the design and construction of the tool-holder would hold a place of distinctly inferior importance to that occupied by the tool itself. But after all, when the holder fails to grip the tool firmly, or when it refuses to go where the tool must go to do the work, it doesn't make much difference how fine the cutting member of the partnership may be; so there is a good deal to be said in favor of making the holder with as much care as is bestowed upon the tool. And the tool manufacturer finds that he really has to do this, and that there are just as many details and just as fussy details to be thought of in the one place as in the other.

For instance; a large Brooklyn tool maker came out some time ago with a brand new idea. In place of the traditional set screw holed into the top of the machine-tool holder, he substituted a cam, holed into the side, directly above the tool channel. As this is turned, its hump bears down on the top of the tool and gives a grip upon the latter which the screw finds it difficult or impossible to duplicate.

But it was found that many users expressed dissatisfaction with the new arrangement; and instead of putting this down to old-fogyism, the manufacturer set himself the task of finding out the real reason for it. And he discovered that, while in the tools of small size it was easy enough to get the tool to fit the channel very closely, this is not the case with larger cutters, which cannot easily be made without a discrepancy of several hundredths of an inch. Obviously when a tool is actually loose in its channel, the play of the screw is greater than that of the cam, and the screw will hold better. So the cam has now been put in its place as an improvement *in certain applications*, and it has been necessary to go back to the screw for other purposes.

This brings up the question of just how strong the screw really is, and just how firm a grip it affords in the cases where it is the proper means. To settle this question the manufacturer took a solid block of high-grade carbon steel and cut an oblong port through it from side to side. Then he sunk a hole from one end of the block *to this port*, and he threaded the hole for the reception of a set-screw. The next step was to select a set-screw from stock and screw it into the hole, and down against the opposite face of the port.



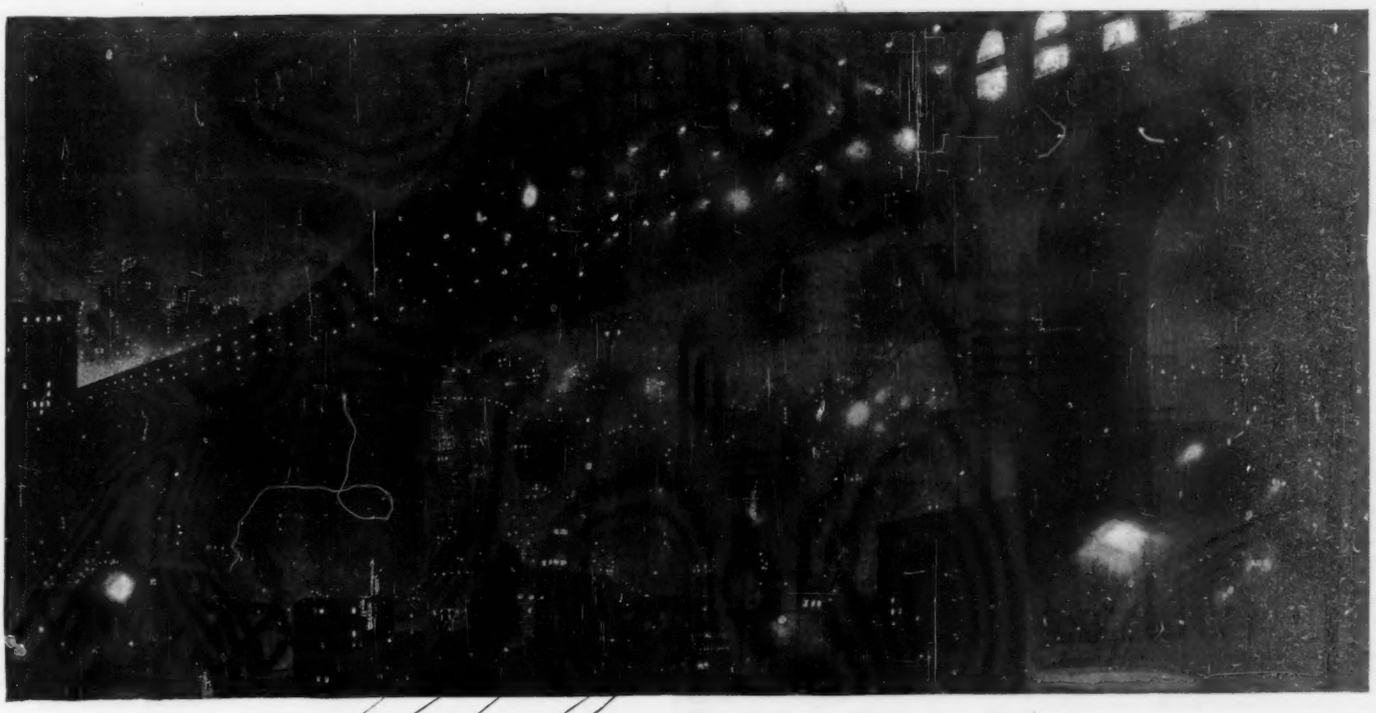
Screwing a set-screw through solid metal to test its strength

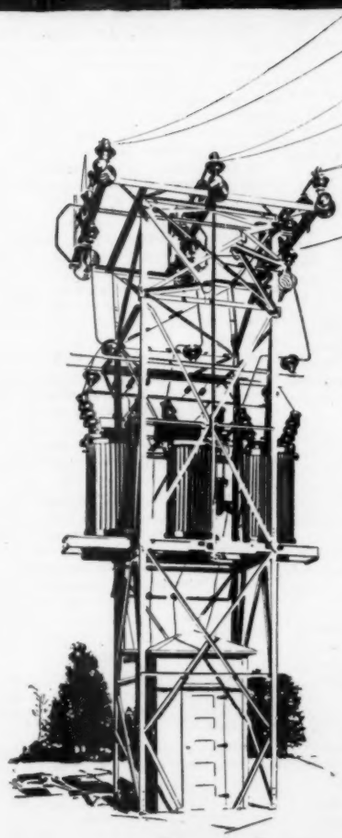
Then a little more power was put on—the intention being to go on screwing the screw against the solid metal between the port and the far end of the block until something broke. But nothing broke—the screw actually penetrated more than a quarter-inch of solid metal without suffering collapse of any of its threads, and came out at the other side, as shown in our cut. The test was therefore a failure in one way—it did not reveal the ultimate strength of the screw! But it was a gorgeous success so far as showing that the screw would stand up against anything that was likely to happen to it in use, and would hold with a very solid grip the tool against which it might be set.

Determining Star Colors

A NEW method of determining star colors, devised by Dr. E. S. King, is thus described in the *Journal* of the British Astronomical Association: Over the telescopic objective is placed a piece of plate glass (commercial glass is good enough for the purpose), which is coated with a gelatine film, one half of which is stained yellow and the other half blue.

The images of the stars are then photographed out of focus on isochromatic plates. Each image, therefore, appears as a disk, one portion of which shows the effect of the yellow light, and the other the effect of the blue light. The two halves of the image are then compared by means of a photographic wedge or by some other similar means.





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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

DOUBLE CUFF.—A. FISHER, 2141 Honeywell Ave., Bronx, N. Y. The invention relates to clothing and has for an object the provision of a structure which may be made in one piece while acting as several. Another object is to provide a double cuff-arrangement with means for securing the same in place, so that one end will act as a permanent single cuff, and the other part will act as a double cuff when in one position, and will be stored out of the way when in a second position.

Electrical Devices

SIGNALING DEVICE.—J. W. WHITE, 20 Congress St., New Rochelle, N. Y. The invention relates more particularly to transmitting and switching mechanisms and circuits. The prime object is to provide a signal transmitting, switching and supervising mechanism which can be constructed of few parts and in such a way that it can be readily adapted to the requirements of all forms of signaling service whether actuated by manual, electrical, mechanical, fluid or gaseous means. An object is to eliminate the human element to a large degree and therefore lessen the expense of maintaining the system.

Of Interest to Farmers

COMBINED TRACTOR AND GANG-PLOW.—T. S. HARRIS, Waverly, Ill. This invention relates more particularly to a three-wheel, single drive, tractor and plow. The prime object is to provide a plow lift, associated with a power-operated actuating means therefor, so constructed and arranged as to counteract and overcome the tendency of the tractor to cant and tip over. The invention also has for an object to provide a power-actuated plow lift arranged to be manually brought into action and automatically thrown out of action when the plows are lifted.

Of General Interest

EXPOSURE IDENTIFICATION DEVICE FOR CAMERAS.—A. F. KELLOGG, Chambers of County Judge, Columbia Co. Court, Portage, Wis. The main object of the invention is to provide means for writing a record upon a film at the time of exposure in order to identify the negative after the development of the exposed film; a further object is to provide a device which eliminates the use of a "window" to make the record, the record being made through a small opening admitting a ray of light, and the medium carrying the opening being moved to move the ray of light, and to provide such a device which may employ a pin or pencil point as a substitute for the ray of light.

SMOKING PIPE.—F. W. BEALL, 1224 Lefferts Ave., Morris Park, L. I., N. Y. The object of the invention is to provide means for thoroughly cleansing the interior passageway of a smoking pipe. A further object is to provide a longitudinal partition between the bowl and the tip of the mouth piece, providing a saliva well without direct communication to the bowl on one side of the partition, and a free draft passage between the bowl and the tip of the mouthpiece on the side, thus insuring a free draft for the smoke and the preservation of the tobacco in the bowl in a dry state.

FLOATING CRAFT OF REINFORCED CONCRETE.—N. K. FOUGNER, address American Steel Concrete Shipbuilding Co., Wilmington, Del. The invention relates to reinforced concrete vessels such as barges and lighters, and particularly to sea-going craft of this kind. The object is to produce a vessel having a double bottom and which can be molded in one operation. The bottom proper is molded in the usual manner on a compact bottom plate and is armed with longitudinal iron rods and cross bars; the inner bottom is separated from the outer one by compartments.

APPARATUS FOR GRINDING OR POLISHING PRECIOUS STONES.—H. DEVRIES and W. A. DONALDSON, 312 Belmont Ave., Newark, N. J. The object of the invention is to provide an apparatus for grinding or polishing diamonds and precious stones, arranged to enable the operator to quickly and accurately adjust the lap-holding device in an up and down direction to correctly locate the precious stone relative to the lap. Another object is to permit the workman to rapidly detach the device from the frame and store it with the precious stone attached thereto during non-working hours in a safe or vault.

FOUNTAIN PEN.—G. DALTON, 73 Gipsey Hill, London S. E. 19, England. This invention relates to that class of self-filling fountain pen in which a central rod with an outside screw head and an internal plug projecting into the pen carrier, acting as a valve for regulating and shutting the supply of ink to the nib, is utilized for carrying a piston, so forming a pump for filling purposes, and has for its object a more reliable way of filling the pen.

ANCHOR FOR SUBMARINE MINES.—G. E. ELIA, Turin, Italy. An object of the invention is to provide an automatic anchor for submarine mines, in which the mooring winch is positively locked in position when the mine reaches a predetermined position with respect to the surface of the body of water in which it is moored. A further object is to provide means for depositing a mine and for permitting the mine to rise to a given height, and for accurately gaging the position of the mine.

MATCH SCRATCHER.—W. B. NICOLL, Fort William, Ontario, Canada. The invention contemplates the production of a neat and simple device in the form of a metallic plate adapted to be secured upon a garment of the wearer, more particularly for the purpose of lighting matches, but which may be used for different purposes, to wit, for sharpening toothpicks or the like.

LID FOR WATER CLOSETS.—M. M. LUSK, 78 Bond St., Brooklyn, N. Y. The object of the invention is to provide a lid for water closets arranged to keep the water in sanitary condition by practically a continuous disinfection. In order to produce the desired result, use is made of a light frame adapted to rest on and cover the seat, and a disinfectant holder mounted on the said frame and extending in the opening of the seat.

ADJUSTABLE SHADE ROLLER.—D. E. SCHIMMEL, 194 Hopper St., Brooklyn, N. Y. The invention has for its object the provision of a construction whereby the roller may be adjusted vertically or to accommodate different size window casings. Another object is the provision of means whereby brackets, nails, and the like are eliminated while the roller is held in proper place. An adjustment of the spring may be made while the roller is in use.

VENTILATED URINAL-CLOSET COMBINATION RANGE.—N. FROST, Bloomington, Ill. The invention relates to a ventilated urinal-closet combination range wherein common flushing, discharging and ventilating means are utilized, the prime object and purpose being the combining of urinals and closets in the same range with common simultaneously-acting connections, and openings leading into a vent duct common to both, irrespective of the particular flushing means utilized.

CHECK PROTECTOR.—R. W. BRANSON, 238 Railway Exchange Bldg., Kansas City, Mo. The invention has for its object to provide a pocket device by means of which the monogram of the drawer of the check may be embossed on the check and inked to provide a distinctive mark. The device comprises a case carrying a roller provided with a roughened surface and an ink pad over which the roller moves when extended beyond the casing. It is so constructed that it may be fitted over the body of an ordinary fountain pen or a lead pencil.

PROCESS OF AND MEANS FOR REMOVING SAND CORES FROM HOLLOW ROLLED METALS.—C. F. PRESCOTT, 131 Fort Green Place, Brooklyn, N. Y. An object of the invention is to provide a means and process for discharging the sand cores from the bores through the action of water or other liquid under tremendous pressure, the liquid acting upon the sand by means of erosion in connection with the physical contact between the nozzle or other means for delivering liquid under pressure to the sand.

EYEGLASS CASE.—B. F. LINDEMAN, 50 E. 12th North, Portland, Ore. The object of the invention is to provide mechanism for use in connection with cases or ordinary construction for preventing the chain from becoming entangled with the nosepiece or other parts and for permitting the glasses to be removed or inserted without the necessity of touching the lenses with the fingers.

Hardware and Tools

HOOK.—D. FLOOD and A. PEARSON, Lindsborg, Kans. The invention has for its object to provide a hook, extending forwardly, laterally in one direction, and rearwardly laterally in the other direction beyond the forwardly extending portion. The object being to provide a hook which may be used on swingletrees and which is simple in construction; to which a trace may be quickly secured without danger of becoming free from the hook by the movement of the horse.

SAW FRAME.—T. PLUNKETT, 33 Pleasant St., Westerly, R. I. This invention while capable of embodiment in various saws is particularly advantageous when embodied in hack saws. The object is to provide means whereby a plurality of cuts may be made at various distances apart and the adjustment for effecting the cuts being adapted to be made with facility; the frame is of simple form involving few parts and providing a strong and durable construction.

HANGING BRACKET.—E. POLLARD, 148 Montague St., Brooklyn, N. Y. Among the principal objects which the invention has in view are, to permit the use of relatively thin metal in the construction of hanging brackets for curtain poles, to provide means for readily resetting the spring members to establish the tension thereof, to provide means for holding between the arms of the bracket, articles of various thicknesses, and to permit the utilization of the bracket for a variety of tool-like purposes.

Heating and Lighting

WATER HEATER.—H. J. HUGHES, 1015 Illinois Ave., Ottawa, Ill. The invention has for its object to provide means in the form of an auxiliary boiler, of greater diameter than the main boiler, for use in connection with the usual house boiler for heating the water within the same by conduction instead of directly, to prevent the deposit of sediment in the water back of the gas heater.

Machines and Mechanical Devices

POWER WASHING MACHINE.—H. H. TOOL and F. C. DUFF, care Clarinda Lawn Mower Co., Clarinda, Iowa. The invention relates to power washing machines and more particularly to a combined washing machine and centrifugal drier. A specific object is the provision of a cylinder having a concentrically arranged rotatable drum for containing the clothes and water, which drum can be oscillated to perform the washing operation, and adjusted to a position with its axis vertical, when the drum can be rotated at a high speed to perform the centrifugal drying or wringing operation.

REGISTER GUIDE AND GRIPPER.—M. T. JOY, 314 E. 163d St., Bronx, N. Y. This invention relates to guides for printing presses. An object is to provide a gripper arm with an extending portion to act in the usual capacity of an arm, and a reduced portion together with a movable guide, the parts being so arranged that when the gripper arm moves to a position on the platen during the printing operation the guide will automatically move for shifting properly the paper on the platen.

SHOVELING MACHINE.—F. M. HEWITT, 1431 West St., Oakland, Cal. The objects of this invention are to improve the guiding means for the shovels in respect to the support and positioning of the shovels in the various positions of the latter in use, as well as the shape of the guideways to prevent lodgement of dropping material thereon. A further object is to provide supporting means in connection with the shoveler, for excavators, together with connecting means permitting of disassociation of the shoveler.

GIN-SAW SHARPENING AND GUMMING DEVICE.—J. J. SMITH, Box 11, McDonough, Ga. The object of the invention is to provide mechanisms for grinding gin saws, wherein a grinding wheel is provided for grinding the throats of the saws, and reciprocating files for finishing the edges of the throats, and wherein other mechanism is provided for advancing the teeth of the saws, the advancing mechanism operating in alternation with the grinding mechanism.

BOLL-COTTON SEPARATOR AND CLEANER.—R. H. PURNELL and R. F. BRIDGES, Box 122, R. F. D., No. 3, Memphis, Tenn. The invention has for its object to provide a device for working cotton into a loose flosculent mass, and is especially adapted for producing two separate grades of cotton from the one machine or for mixing the two grades in the machine.

Prime Movers and Their Accessories

DISTRIBUTOR.—P. C. HAAS, address J. C. Martin, 420 S. Division St., Ann Arbor, Mich. The invention relates to distributors for the spark plugs of internal combustion engines, and has reference more particularly to the means for breaking the primary circuit. An object is to provide a distributer which has liquid interrupter, the liquid being a conductor, and which is mounted to reciprocate to and from a stationary contact taking place within a hermetically sealed chamber.

HEATER.—C. C. PIRTLE, Herebard, Texas. The object of this invention is to provide a heater especially adapted for use with internal combustion engines, for the preliminary heating of the manifold before starting, to assist in starting in cold weather. The device is especially adapted for existing engines, being capable of attachment to the manifold, but might be cast with the manifold, forming an integral part thereof.

INTERNAL COMBUSTION ENGINE.—E. F. O'HAVER, Box 331, Carlisle, Ind. The object of the present invention is to provide a rotary internal combustion engine arranged to produce any desired number of explosions in the combustion chamber at each revolution of the rotor, or to have a continuous or constant combustion in the working chamber with a view to permit of developing more or less power as required at the time for a given load. Another object is to permit the use of gasolene, kerosene or other liquid fuel as the motive agent.

ROTARY ENGINE OR PUMP.—H. E. LITTLE, Picture Rocks, Pa. The invention relates to rotary engines and pumps in which a horizontally rotating piston and piston disk operate in conjunction with two or more diametrically opposite geared abuttments rotating vertically, the objects are first, reduction of vibration, and consequently a smaller foundation and lighter base, second, the greater speed it may run in safety, third, the economical consumption of power by making steam and water tight compartments by the use of packing rings, and fourth, the great reduction in wear of bearings.

Pertaining to Vehicles

COVERING.—W. ACHTMEYER, Middletown, Conn. The object of the invention is to provide a moisture-proof covering for extra tires usually carried by automobiles. Another object is to provide a snugly fitting cover which can be readily placed in position or removed, the cover being of a fabric capable of being folded up flat to take up very little room for storing or other purposes.

STABILIZING AND STEERING GEAR FOR VEHICLES USING CHAIN TRACKS.—P. W. ROBSON and F. J. BRETHERTON. Stamp End Works, Lincoln, England. This invention consists in mounting steering wheels on a frame pivoted to the main frame of the machine so that it can turn freely about a vertical axis and also turn about a horizontal axis, being normally pressed down on the road by means of springs, but capable of being raised by a hand operated mechanism.

SEAT RAIL ATTACHMENT FOR TOP CARRIAGE.—O. N. ROBARDS, 426 6th St., Henderson, Ky. The invention is embodied in the form and construction of the seat rail proper, the means of attachment of the same to the carriage seat-irons, and the provision of a hook adapted to engage the front brace of a carriage top for holding the latter distended.

DEVICE FOR NEUTRALIZING SHOCK.—C. B. BILLINGHURST, 303 Dakota Ave., Pierre, S. D. The object of this invention is to provide mechanism in connection with motor vehicles of every type for neutralizing metallic vibration wherein a non-metallic element in the form of a disk of rubber is interposed between the body of the vehicle and the frame for interrupting and neutralizing the metallic vibrations.

Designs

DESIGN FOR AN ARTICLE OF MANUFACTURE.—M. BAUMAN, 170 Broadway, New York, N. Y. This ornamental design is for a finger ring.

DESIGN FOR A DISPLAY STAND.—A. VERICEL, 315 W. 136th St., New York, N. Y.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—K. A. KELLY, 216 W. 102d St., New York, N. Y. The design is in the form of an ornamental brooch or lace pin, showing an eagle with the flags of United States, England, France, Belgium and Italy.

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Allied Nations Scientific Academies to Those of the Central Powers

THE National Academy of Sciences of the United States of America publishes the following declaration:

"When more than four years ago the outbreak of war divided Europe into hostile camps men of science were still able to hope that the conclusion of peace would join at once the broken threads, and that the present enemies might then once more be able to meet in friendly conference, uniting their efforts to advance the interests of science; for ever since the revival of learning in the Middle Ages the prosecution of knowledge has formed a bond strong enough to resist the strain of national antagonism. And this bond was strengthened during the latter part of last century, when branches of science developed requiring for their supply the coöperation of all the civilized nations of the world. International Associations and Conferences rapidly multiplied, and the friendly intercourse between the learned representatives of different countries grew more intimate in spite of their political differences, which were admitted, but not insisted upon.

"In former times war frequently interrupted the coöperation of individuals without destroying the mutual esteem based on the recognition of intellectual achievements; peace then soon effaced the scars of a strife that was ended. If today the representatives of the Scientific Academies of the Allied Nations are forced to declare that they will not be able to resume personal relations in scientific matters with their enemies until the Central Powers can be readmitted into the concert of civilized nations, they do [illegible] full sense of responsibility, and they feel bound to record the reasons which have led them to this decision.

"Civilisation has imposed restrictions on the conduct of nations which are intended to serve the interests of humanity, and to maintain a high standard of honor, such as the recognition of the sanctity of treaties—especially those designed to apply to a state of war—and the avoidance of unnecessary cruelties inflicted on civilians. In both these respects, the Central Powers have broken the ordinances of civilization, disregarding all conventions, and unbridling the worst passions which the ferocity of war engenders. War is necessarily full of cruelties; individual acts of barbarity cannot be avoided and have to be borne. It is not of these we speak, but of the organized horrors encouraged and initiated from above with the sole object of terrorizing unoffending communities. The wanton destruction of property, the murders and outrages on land and sea, the sinking of hospital ships, the insults and tortures inflicted on prisoners of war, have left a stain on the history of the guilty nations, which cannot be removed by mere compensation of the material damage inflicted. In order to restore the confidence without which no scientific intercourse can be fruitful, the Central Powers must renounce the political methods which have led to the atrocities that have shocked the civilized world."

Some American Substitutes for Rubber

(Continued from page 8)

and then again he may say that the hose is not strong enough to siphon water out of a tank. Who is right? Can it be that all rubber shoes are made of poor, cheap compounds, and is it true that garden hose is getting worse and worse each year? The answer is probably in that sentence which says: "It's human beings, not the times, that are getting worse." We use our footwear more continuously, we take longer walks on wet days, and we wear our gums, even on dry days, to keep the feet warm. Am I right? The suburbanite hangs his garden hose on the fence—sometimes in a reckless manner. Each kink develops a blow-out all its own, and the fabric when once exposed to water will soon

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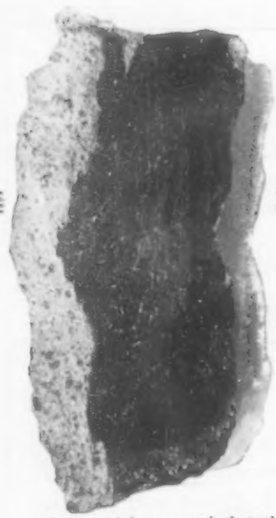

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rot. But these explanations must not be accepted for all cases. It is well known to the rubber trade that some manufacturers have an elastic conscience. I would remind you of those eminent patriots who made rubberized fabrics for army slickers last year. But fortunately, the large proportion of these rubber goods manufacturers are real Americans, and it is they who have made possible the colossal achievements of the last few years.

There is another article of commerce which brings the consumer into close relation with the rubber trade. It is the hot-water bottle, which has cured cold feet, and brought comfort to the invalid. But here let me state that most of the worry caused by these bottles has its origin in the careless treatment given them by the housekeeper. And I might add that a recent examination of over one hundred hot water bags returned to one manufacturer for adjustment, showed that the most common mistake made in our homes is this: we allow olive oil, or turpentine, or some other grease to come in contact with the flat surfaces of the hot water bag. And in saying this I have told you what to avoid, if you would maintain the life of a good bottle. I might, of course say that some compounds are poorly adapted for the manufacture of this product, but this is a matter which must be left to the good judgment of the maker. If he wishes to maintain his business he must use skill in his plant. In this connection I might state that recent experiments have shown that high grade hot water bottles *resistant* to most of the above influences *can be made*.

Great Britain's Giant Bombing Plane

(*Continued from page 10*)

civil engineer to the Egyptian Government, and, joining the Royal Naval Air Service, specialized on the engineering side of big machines. He was responsible for the engineering organization, and took part in the flight of one of the early Handley-Page machines from London to Constantinople in 1917, then a world's record flight, and for his services on this and other expeditions was awarded the D. S. C.

After collaborating on the preliminary details, and after carrying out a great number of experiments, applying the special methods of construction proposed, the next step was to obtain permission to build a machine; and it is admitted by all that, if it had not been for the enterprise and practical encouragement of Lord Weir, the late Air Minister, the machine would probably never have been built, or at least would have been very considerably postponed.

Lord Weir, when placing an order for two machines, stipulated the observance of several very important principles. Foremost among these were:

1. The machine when completed should be capable of bombing German industrial centers from a station in England and returning thereto.

2. That all the materials should be drawn from home sources, and that the methods of wood construction to be followed should allow of the use of entirely home-grown and inexpensive timber.

3. That the machine should be of such a character as would enable it to be principally constructed with female labor.

The fact that these principles were duly observed, and at the same time the machine did not suffer in the slightest degree from the conditions, reflects the highest credit on all concerned. At the suggestion of Lord Weir the erection of the machine was entrusted to the Royal Aircraft Establishment at Farnborough. The dirigible shed—there was none other large enough—was prepared for the erection, and the arrangements drawn up for the building of this gigantic structure. In addition, the whole of the metal fittings were made and assembled along with the controls and thousands of other vital details in due course.

Unfortunately, the first Tarrant airplane, known as the "Tabor," was destined to be short lived, despite the months upon months of painstaking work involved in its construction. In a few minutes' time the entire structure was destroyed, along with the annihilation of the results of so much labor.

It was on May 26th last that the "Tabor" machine was prepared for its trial flight. While running along the ground preparatory to taking off, the machine suddenly dug its nose into the ground, with serious damage resulting. Captain Rawlings, D. S. C., who was aboard the huge machine, died shortly after the accident, while Captain Dunn, A. F. C., was seriously injured.

With regard to the accident itself, it is difficult to ascertain the exact cause. It would appear that the machine was traveling along the ground at high speed with the four lower engines running, and that, in order to get sufficient speed to rise, the pilot opened out the two top engines, which had up till then been throttled down, with the result that the extra thrust, applied so far above the center of resistance of the machine, brought the tail up. The momentum thus imparted to the machine, especially that of the two top engines, was, at any rate momentarily, too great to be overcome by the tail planes and elevators, and the result was that the machine turned on her nose. It is quite conclusive that had the machine been in the air the momentary pitching could have been corrected by trimming the tail, but on the ground there was no time in which to do this before the machine was over.

However that may be, the Tarrant machine presents a big step forward in the art of heavier-than-air flying, and even at this writing another machine is well under way. In the first place the Tarrant triplane is large and, as remarked earlier, its internal construction is such as will permit passengers to be carried in a roomy and perfectly comfortable manner. Sleeping accommodations can be provided equal to anything furnished on trains, and passengers will be free from the shaking and vibration that has to be endured on even the best lines.

The range of the machine is such that the following places are brought within 24 hours of London: Cairo and Mesopotamia to the east, the west coast of Africa and Cape Verde to the south, the whole of Norway, Sweden, Finland, Lapland, or Petrograd and Moscow to the north, and also probably America to the west. The next day's run could be extended an equal distance.

The details of the first Tarrant machine were as follows:

Span (middle plane)	131 feet 3 inches
Span (top and bottom planes)	98 feet 5 inches
Total surface of wings	4,950 square feet
Overall height	37 feet 3 inches
Overall length	73 feet 2 inches
Body (maximum diameter)	11 feet
Gap (between all planes)	14 feet 9 inches
Chord	15 feet 2 inches
Dihedral (all planes)	4 degrees
Total weight	44,672 pounds
Fuel capacity	1,600 gallons or 12,662 pounds
Oil and tanks	92 gallons or 1,050 pounds
Crew	5 or 1,080 pounds
Guns and ammunition	380 pounds
Bombs and gears	4,650 pounds

The machine, with its six 500-horsepower Napier "Lion," engines was designed for a full load speed of 90 miles an hour with two engines cut out. Of the total weight, fully 45,000 pounds, 19,000 was useful load. With all engines on the plane was designed for a speed in excess of 110 miles an hour, while the ceiling or maximum height obtainable was figured at 13,000 feet. The maximum range at cruising speed was estimated at 1,200 miles.

Great Changes in the Planet Jupiter

(*Continued from page 11*)

We cannot assume that the Red Spot is finally gone. A similar marking appeared to Cassius Hook and others in the

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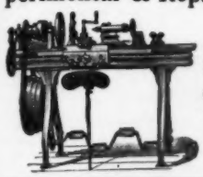

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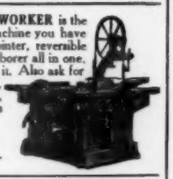

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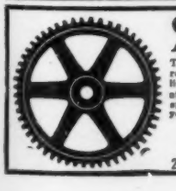

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seventeenth century. Mr. Frank Sargent, F. R. A. S., of Bristol, England, appears to have been one of the first, if not the first, to have detected the recent changes that have so much affected the normal configuration of Jupiter. He used a 10½-inch reflecting telescope and a five-inch Cooke refractor equatorially mounted. My own instruments are at present not available for use, but I have no doubt that the students of this highly interesting planet will confirm the results obtained at Bristol.

In fact, correspondence with the leading planetary observers in England has elicited numerous details with regard to the remarkable variations that have recently taken place. It appears that though the Red Spot hollow and the south tropical disturbance have disappeared, there are still unmistakable traces of the Red Spot itself. Our leading observer of Jupiter, the Rev. T. E. R. Phillips, has kindly sent me some recent drawings and observations from which it is certain that the elliptical outlines of the Red Spot continue distinguishable on a good night. The marking seems darker at its following end. Mr. Phillips uses telescopes of eight-inch aperture (refractor) and 12-inch (reflector), and remarks that "though the south tropical disturbance and Red Spot hollow have practically disappeared, the Red Spot is still quite distinct to my eye, but it requires a night of good definition to enable me to make out all the details. Recent changes have been rapid and most remarkable. It will be a satisfaction to many observers that the Red Spot is holding its own, and it is to be hoped that the disintegrating forces or whatever it be that has caused the extraordinary variations will not ultimately result in the elimination of this well known marking."

How the Metereologist Aids the Aviator

(Continued from page 11)

more than 200 regular stations in the larger cities where complete weather records are kept. From the data gathered from these various sources forecasts for the special benefit of aviators are now being made, with a fair degree of success.

While observations of clouds and drifting smoke give a clue to the conditions aloft, the most valuable data are obtained by means of recording instruments sent aloft by means of kites or balloons. The kite usually employed is a modified Hargrave box-kite. The latter is used partly because it is stable and partly because it will lift a considerable weight. The line used is music wire of great tensile strength, and it sometimes happens that six or seven kites are used in tandem formation to lift a great length of line. In the small building shown in our third photograph there is a steam-driven steel reel which lets out or takes in the line as required. The self-recording instrument, called a meteorograph, is attached to the line just below the leading kite. On a sheet wrapped around a revolving drum an ink trace is automatically made of barometric pressure, temperature, relative humidity and wind velocity. A clock inside of the cylinder causes the latter to revolve at a fixed rate.

When the wind at the ground is too light to lift a kite a captive balloon is used to raise the meteorograph. When wind data alone are desired a small pilot balloon made of rubber and filled with hydrogen gas is liberated. Observations are made at frequent intervals by means of a surveyor's transit-theodolite, at one or at two stations. By means of triangulation these data are used to determine the wind velocity and direction aloft. Occasionally a small meteorograph is sent up attached to a sounding balloon. When the latter bursts aloft because of the expansion of the inclosed hydrogen gas a parachute brings back to earth the delicate recording instrument with its graphic record.

The experiments referred to above have now been carried on for about a quarter of a century and a considerable amount of

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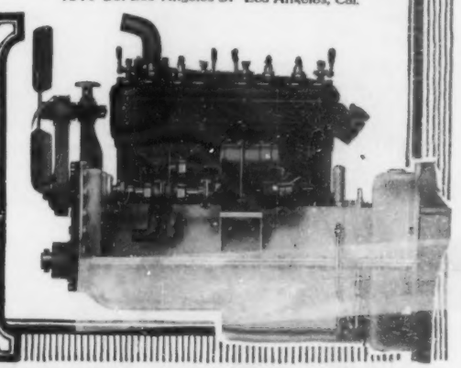

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knowledge has accumulated which is of practical value to the aviator. While it would be impossible to condense in small space all that may be of interest, a few of the salient principles will be given in the following.

With the increase of height the following changes occur: The barometric pressure invariably diminishes, the temperature generally falls, and the wind velocity usually increases. Throughout the United States the winds above a height of one mile are generally from some westerly direction. All easterly winds, like the sea-breeze of the Atlantic coast, are superficial, and the place of contact between the low easterly winds and the prevailing westerly winds aloft is a treacherous region for the aviator. Gusts, which consist of adjacent air masses moving with irregular or different velocities, are also very superficial, and are found only near the surface of the earth. When, during the summer months, there are visible in the sky isolated masses of cloud of the cumulus type, or thunderstorm clouds of the cumulo-nimbus type, vertical convection is in progress. Under these conditions an aviator may encounter vertical columns of ascending air with velocities sufficient to disturb the equilibrium of an airplane in flight. "Holes in the air" are largely fiction, as the atmosphere is more or less homogeneous and continuous, and allows no vacuum to form within it. But in ascending currents topped by cumulus clouds, or in horizontal rolls of air as indicated by rolls and ripple-marks in cloud strata, the air is unstable, and density and pressure vary within short distances. The experienced aviator knows that great caution is necessary for safety when flying under these conditions.

Rain and fog appear to be the aviator's greatest obstacles, as far as the atmosphere is concerned. The meteorologist can offer no suggestion in such conditions other than that of seeking altitude. Rain clouds are generally low clouds, and fog is simply a cloud resting upon the ground. Safe flight during rain and fog seem to demand that the aviator rise to the clear air strata aloft.

Aviators are advised to become familiar with the daily weather map published at all regular stations of the U. S. Weather Bureau. If he can interpret the weather map in terms of weather conditions aloft he will often find the knowledge of paramount importance. On the weather map will be found surrounded by lines various irregular but generally circular areas marked "High" and "Low." These terms refer to barometric pressure at the ground. But it is known that the relative pressure distribution determines in large measure the weather conditions, both at the ground and aloft. The region of a "High" is one of clear weather, cold in winter, warm in summer, with light winds blowing spirally *outward* from the center. As an aviator ascends in a "High" the winds increase in velocity and almost invariably become westerly in direction. The region of a "Low," on the other hand, is one of cloudy and rainy weather, relatively warm, with moderate to strong winds blowing spirally *inward* toward the center. At the rear of the "Low" the weather is clearing, the temperature falling, and the winds, increasing in velocity, are swinging around to some westerly point. A "Low" is not a favorable region for flight, but if an aviator can gain a moderate elevation he may be able to rise above the rain-clouds into clear air. The "Highs" and the "Lows" move alternately in endless procession across the United States from west to east at a rate of about 300 miles per day, and cause the frequent changes which characterize our weather.

The pioneers in aeronautical research, Lilienthal, Langley, Chanute, the Wright brothers and Curtiss, all had more than an elementary knowledge of meteorology and atmospherics. They found that such knowledge was as necessary for successful experimentation as a working knowledge of mathematics is to the successful engineer. On the other hand, the meteorologist has learned much since aviation made it possible for one to ascend readily to heights of five or six miles above the ground. Now that aerial navigation has become an established means of transportation it is probable that the meteorologist and the aviator will find it mutually advantageous to coöperate even more intimately.

Taking the Plod Out of Plowing

(Continued from page 13)

to move. By hitching the four horses in tandem formatiom, two and two, a perfectly straight line of pull was established and the wasteful side draft was eliminated.

But in driving teams tandem one of the big stumbling blocks was to divide the load evenly among the various teams. It was finally removed by using pulleys and block-and-tackle arrangements. The multiple-pulley hitch, as it has come to be called, divides the load perfectly no matter whether two, three, four or five teams are used. A ten-horse or five-team hitch arrangement can be used for eight horses by simply dropping off the rear unit. If only six horses are to be used the two rear units are cut out.

The horse is built in such a way that when he is hitched close to the load at the usual distance from the ground the line of draft will be at right angles to his shoulders. But when teams were strung out tandem fashion, as the distance from the implement or load increased the higher was the line of the trace or tug; the pull was not at right angles to the shoulders and the horse was not efficient or comfortable. The difficulty was overcome by placing weights of 40 or 50 pounds on the double trees of the swing lead teams. These weights hold the traces down so that the angle made with the collar or shoulder is the same in every horse no matter whether he is a leader or one of the wheelers.

In driving these tandem teams, even when as many as ten horses are being used, only one pair of lines is required. They are attached to the leaders. The other teams are kept in their places by what is known as the system of tieing in and bucking back. When any team pulls forward beyond the limit arranged for, the draw rod pulls on the bucking straps and checks the horses. We might call them automatic lines rather than buck straps. They do what a man would do if he wanted to bother with several pairs of lines.

Anyone who understands the principle of the block and tackle can readily understand how in this multiple-hitch plan the load is equalized among the various teams. Let us take a ten-horse hitch, for example: The leaders and the swing team just behind pull against each other over a single pulley. The second swing team pulls against the two teams ahead over two single pulleys. The first swing team pulls against the three teams ahead over a single and a double pulley. The wheelers pull against the four teams ahead over two double pulleys that are attached to the plow or other implement. Finally, as at present, the horses of each individual team of two pull against each other by means of the double-tree lever with the fulcrum in the middle.

Special tandem hitch devices have been developed for wagons and disk harrows. The farm power experts recommend that two teams of three horses each be driven tandem to the disk harrow; that is, when more than four horses are needed. Four horses can be worked abreast to this implement without any difficulty. But owing to the width of the beaten roads only two can be worked abreast to a wagon.

The need for large teams of heavy horses is plain to anyone who understands the nature of farm work. The draft of a 14-inch, single-bottom plow varies, depending on the depth of the furrow, type of soil and other conditions, from 150 to 1,000 pounds. Under average conditions

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when the farmer is plowing his land six inches deep the pull will be from 300 to 400 pounds and when that same soil becomes dry and hard the draft may be increased to, say, 700 pounds or more. A horse working at the normal plowing speed of two and a half miles an hour can pull one-tenth of his own weight. Therefore, under good conditions it will take two 1,500-pound horses or three averaging 1,000 pounds to handle a 14-inch plow, and when the ground is in bad condition four 1,500-pounders will be needed. Most farmers use too little horseflesh in doing the heavy spring work.

With the wages for farmhands at the present high level and men scarce at any price the adoption of some such system becomes absolutely necessary. When one man can handle eight or ten horses effectively he is doing the work that is ordinarily done by three or four men. The average farmhand can learn in a few hours to handle six, eight and ten horses hitched tandem, two and two. At the demonstrations that have been put on at various places in the Corn Belt by the Percheron Society in coöperation with Professor White, men who had never driven such teams before had no trouble from the start after the appliances had been properly adjusted. In nearly all cases the horses had never been worked tandem but they caught on almost immediately. And little more need be said for the new hitch than that one man with eight good draft horses can plow 50 acres a week with a three-bottom plow.

Water Resistant Glues

WATER resistant glues are of two general types, those made from blood albumen and those made from casein. All blood-albumen glues are made directly from the raw ingredients at the time the glue is to be used. The manuacturers using these glues make them by their own secret formulas, and there are no published formulas available. Casein glues are made from casein, which is obtained from milk. They can be obtained in the prepared state ready for mixing with water, or they can be made directly from the ingredients at the time the glue is to be used.

The water resistant qualities of casein and blood glues are well demonstrated by the acceptance test imposed on plywood manufactured with these glues for use in airplanes. Samples of the plywood are boiled in water for 8 hours or soaked in cold water for 10 days. An acceptable product will show no separations of the plies under such treatment.

The shearing strength of casein and blood glues in plywood for airplane use is required to be at least 150 pounds per square inch. Most of the plywood tested at the Forest Products Laboratory showed values considerably higher than this minimum requirement. In general, veneer panels glued with blood glue show higher average strength under the varying conditions than those glued with casein glues. It seems possible, however, that casein glues will in time be developed which will be the equal of blood albumen glues in this respect.

Both casein and blood glues are materially weaker wet than dry. Casein glues tested wet commonly have 20 to 40 per cent of their dry plywood shear strength, and blood glues 50 to 75 per cent. When plywood using these glues is redried after being soaked, however, the original strength of the glue is very largely recovered.

Blood glues are not at present commonly used for gluing anything thicker than veneer. Casein glues are used for gluing all thicknesses. Casein glue test joints, using blocks of maple with the grain running in the same direction, commonly have a shearing strength of 2,000 to 2,500 pounds per square inch.

Blood-albumen glue joints must be made with a "hot press" (having hollow plates heated with steam); a few minutes pressure is sufficient. Casein glue requires only an ordinary press, such as is used, with or without retaining clamps, for animal and vegetable glues. The spreading equipment used for vegetable glues is suitable for both casein and blood albumen glues.

Variations of Length Caused by Magnetization

THE term "magnetostricture" is applied by Mr. D. Hurmuzescu to the changes in length, accompanied by changes in volume, which magnetizable bodies undergo when subjected to the influence of a magnet.

In course of his studies of these variations Mr. Hurmuzescu made use of the Fizeau method of measurement by means of the displacement of interference rings. The results observed in experiments on a large number of ferromagnetic bodies, as recently reported to the French Society of Physics, are as follows:

Soft iron begins to increase in length with an increase in the magnetic field; this elongation passes through a maximum for a field of somewhat less than 200 Gauss, and is then successively diminished, annulled, and made *negative*, *i. e.*, there is a shortening of the body.

Steel behaves in a manner which is analogous, except that the maximum elongation is of less degree and is produced by fields of greater intensity.

Nickel is decreased in length at the start, the action being abrupt and with an absolute value much greater than in the case of iron, after which, however, the variation becomes slower.

Cobalt is likewise made shorter to begin with; this decrease in length successively diminishes, is annulled, and decreases in length and changes into an elongation.

By attentive observation of this curious phenomenon in its maximum and minimum phases, *i. e.*, in the critical portions of the curves recorded, Mr. Hurmuzescu discovered a characteristic oscillation denoting an unstable state of molecular equilibrium. This instability is manifested upon the direct establishment, starting with a very low value, of a magnetic field slightly greater than that corresponding to the maximum; the displacement of the rings, by which the variation in length is revealed, undergoes an abrupt change of direction. The degree elongation is always less than that of the abbreviation, and the farther the point of the curve under observation is from the maximum, the greater this is; in all cases the phenomenon diminishes and finally disappears at a given distance from the maximum

The experimenter failed to observe this molecular instability in the case of nickel or in that of steel (in which latter, however, the curve of elongation exhibited a maximum). It was displayed in all specimens of soft iron, and was most distinctly marked when the iron employed had the weakest coercive field.

This observation induced Mr. Hurmuzescu to experiment with artificial magnetic systems capable of greater actual mobility; the importance of this resides in the possibility of giving concrete form, to a certain degree, to the theories regarding molecular magnetism. As we know, Ewing sought to verify Weber's hypotheses concerning the arrangement and orientation of the elementary magnetons of magnetic bodies by his experiments with a large number of magnetic needles. In these experiments, which have been repeated more recently by M. M. De La Rive and Ch. Eng. Guye, the configurations assumed by the magnets in consequence of their reciprocal attractions and repulsions pass through an unstable state of equilibrium for a certain value of the external field of magnetism; on one side or the other of this critical field the needles take on an aspect which differs from that of a state of stable equilibrium; by causing the magnetic field to vary very slightly. This unstable condition of the magnets can be shown. The instability observed by Mr. Hurmuzescu is analogous to this and is displayed only in bodies having a certain magnetic molecular mobility

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Few people realize that the *rear axle* of an automobile is, next to the engine, the most important mechanical factor in producing a good automobile. The engine's power is transmitted to the rear (driving) wheels through the pinion gear of the propeller shaft and differential mechanism—all part of the *rear axle*.

The *rear axle* of a carriage or wagon carries the weight of the vehicle on the spindle. The *rear axle* of an automobile carries the weight of the vehicle on its *housing*—the pressed steel case which encloses the differential gear, driving shaft and all bearings—and includes the wheel hubs, brakes and brake mechanism complete ready for use.

One may better understand the importance of the *rear axle* when it is said there are over 150 individual parts of the *rear axle* mechanism that must be carefully machined and fitted to micrometer measure. This mechanism must be compact, silent and of great strength to transmit the power of the engine to the driving wheels with the least possible friction or loss of power.

The Salisbury New Pressed Steel Rear Axle is produced in our two big plants after 15 years' successful building of front and rear automobile axles, complete with hubs and brakes. It combines the great strength and durability of our own special formulae steel with simplicity of construction. Made in three standard sizes for cars weighing 1700 to 4000 pounds.

The automobile manufacturer who specifies our axles adds a strong selling point to the prospective purchaser.

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NEW BOOKS, ETC.

THE NEW YORK CHARITIES DIRECTORY. By Lina D. Miller. New York: Charity Organization Society, 1919. 12mo.; 462 pp.

Still retaining its old title, this annual has gradually come to embrace practically all the social services of Greater New York. Each edition sees extension and improvement; any agency may be found if either the title or the nature of its work be known; there is a separate list of churches, and another list of the persons prominent in organized efforts toward human betterment. The name index gives more than 5,000 names and refers the reader to full descriptions of the organizations in which these individuals are active or interested.

GAS, GASOLINE AND OIL ENGINES. By A. Frederick Collins. New, York and London: D. Appleton and Company, 1919. 8vo.; 207 pp.; illustrated.

In easy, popular style, the author sketches the beginnings of the internal combustion engine, explains the construction and workings of the modern engine in its various forms, and deals with the elements of economy and efficiency. There is an illustration on almost every page, and the writer has succeeded in conveying a wide elementary knowledge of his subject in the simplest possible words.

THE WHOLE TRUTH ABOUT ALCOHOL. By George Elliot Flint. New York: Macmillan Company, 1919. 8vo.; 294 pp.

Does the immoderate use of alcohol produce the defective, or is it rather that the ranks of the defectives furnish the drunkard, the drug addict, and the criminal? The author inclines to the latter contention. He considers the drink habit and the probable effects of national prohibition physiologically, psychologically and economically, makes some sharp attacks upon the extreme reformer and scores a few points for the moderate drinker. On the whole the arguments are soundly conceived and strongly presented, though we cannot agree with the writer that there is no such thing as a beer alcoholic.

THE DIAGNOSIS OF DISEASE BY OBSERVATION OF THE EYE. By Peter Johannes Thiel. Translated by Dr. F. W. Collins. Part Two, Volume One. Newark, N. J. (122 Roseville Avenue): Mecca Supply House, 1918. 8vo.; 76 pp.; illustrations and charts.

This is a translation from the German that claims to enable physicians, teachers and parents to read the eyes diagnostically. It puts forward the curious theory that all lesions of the body are recorded in the iris as colored spots and scars; hence the name "Iridology."

BUILDINGS, EQUIPMENT, AND SUPPLIES. New York: A. W. Shaw Company, 1919. 8vo.; 214 pp.; illustrated.

This volume of the Shaw Banking Series cites and solves the problems of location and construction of bank buildings and of serviceable and time-saving equipment and supplies. The planning of the interior—the lobby, the cage, the executive offices and the vaults, and its lighting, heating and ventilation, are considered with a view to the pleasure and comfort of the customers as well as despatch of business. The right sort of equipment means more business handled in less space, with the resultant economy in time and money. Often profit leaks out as the door is opened for supplies to come in; here again the suggestions are sound and practical. The volume is in all respects worthy of commendation.

THE BLUE GUIDES—MUIRHEAD'S LONDON AND ITS ENVIRONS. Edited by Findlay Muirhead, M.A. New York: The Macmillan Company. 501 pp.; 30 maps and plans.

At last we have the successor to "Baedeker" which was found in the last analysis to be an activity of the German General Staff. (See the SCIENTIFIC AMERICAN for November 2d, 1918, page 354.) If we do not mistake, Mr. Muirhead wrote the former "Baedeker" London, although he had of course, no knowledge of the wicked plans of the wicked General Staff. In the present instance we find an admirable guide, a little taller, but still for the pocket. The task has been well performed, and only those who have written guide books, as has the writer of this review, can pass upon it competently. The only criticism that will be made is that the maps are not quite as bright and clear as their German prototypes; this could be corrected by using a bright red instead of a sickly yellowish white. The arrangement is admirable, and considering the severe conditions imposed by the war the work is a creditable production for author and publisher. Nevermore will the accursed little red books of Leipsic be used by the English-speaking traveler and we sincerely hope that the plates were all requisitioned by the Imperial German Government, not for ammunition, but in the interests of peace.

LIFE MOVEMENTS IN PLANTS. Vol. I, Parts 1 and 2, of Transactions of the Bose Research Institute. By Sir Jagadis Chunder Bose, M.A., D.Sc., Calcutta: The Bose Research Institute, 1918. 8vo.; 266 pp.; 92 illustrations.

The author is Director of the Bose Research Institute, and one of the few scientists of the East whose reputations extend to our western world. By means of the most delicate instruments, he enabled plants to express in "writing" their "feelings"—their responses to intoxicants, to shock, to anesthetics, to poisons. The volume in hand summarizes his investigations in the response of plant organs, and growth and its responsive variations. His explanation of the "Traying Palm Tree" deals with a remarkable phenomenon, and the paper on the high magnification crescograph for researches on growth is another valuable contribution.

RESOURCES AND INDUSTRIES OF THE UNITED STATES. By Elizabeth F. Fisher. New York: Ginn and Company, 1919. 8vo.; 246 pp.; illustrated.

This meritorious grammar school text presents the soil as man's great treasure chest; how the industries go to the soil for their raw materials and how they turn these into finished products is interestingly told. The work visualizes industrial processes and stimulates thought. Among the many illustrations are relief, rainfall, temperature and soil maps, the latter a unique simplification indicating the origin and distribution of the soils of our country.

PHYSICS AND CHEMISTRY OF MINING AND MINE VENTILATION. By Joseph J. Walsh, Mine Inspector. New York: D. Van Nostrand Company, 1918. 8vo.; 219 pp.; illustrated.

The reception accorded the first edition of this work, which addresses itself to vocational students and to those qualifying for mine foreman and mine inspector certificates, has led to an amplified second edition with a new chapter on the sampling and analysis of mine gases. In treating of ventilation, it emphasizes the really important principles not now so well understood as they should be by the student. It aims at a more suggestive method of study in a more graphic form.

HOUSEWIFERY. A Manual and Text Boks, of Practical Housekeeping. By Lydia Ray Balderston, A.M. Philadelphia and London: J. B. Lippincott Company, 1919. 8vo.; 353 pp.; 176 illustrations.

The housewife is learning to consult good reference books just as do all other business managers—to keep in touch with labor-saving methods and modern knowledge. A highly competent instructor here brings together in a single volume everything pertaining to the business of running a successful home. Equipment and trouble-banishing appliances are described, there are chapters on household supplies, furnishings, and storage, on the cleaning and care of rooms, on the cleaning and renovation of fabrics, leather, metals and woods, and on disinfectants and fumigants. The essentials of plumbing, heating and lighting are also presented.

THE CIVIL ENGINEER'S POCKET-BOOK. By John C. Trautwine, C.E. Revised by John C. Trautwine, Jr. and John C. Trautwine, 3d. Philadelphia: Trautwine Company, 1919. 12 mo.; 1602 pp.; 1250 illustrations.

Every engineer knows that "Trautwine" stands for a classic into which three generations have put their talent and experience; the precautions taken against errors and obscurities extend to the authors' invention of unique devices and new machinery. This 20th edition is thumb-indexed, and contains more than 350 new pages relating to railroads. Important elementary principles are shorn of their difficulties: the tables given have not been accepted without elaborate recalculations. The practical applications of mathematics, natural phenomena and mechanics are simplified and summarized, and an exhaustive treatment of constructions, water supply, traction, bridges, and railroads follows. The work has the highest endorsements of Army and civilian engineers.

PRINCIPLES OF GOVERNMENT PURCHASING. By Arthur G. Thomas. New York and London: D. Appleton and Company, 1919. 8vo.; 275 pp.

This is an intensive study by an expert on the determination of purchase requirements and the satisfactory consummation of purchase transactions. Purchasing by private concerns is a different and less complex problem, since Government agents are hampered by rigid legal requirements that enhance the difficulties of the situation. The basic principles and considerations of Government purchasing are set forth, followed by an outline of the process and a detailed study of the various factors entering into bids, agreements, negotiations, inspection, and clerical work. It is a clear exposition of an important technical problem of administration.

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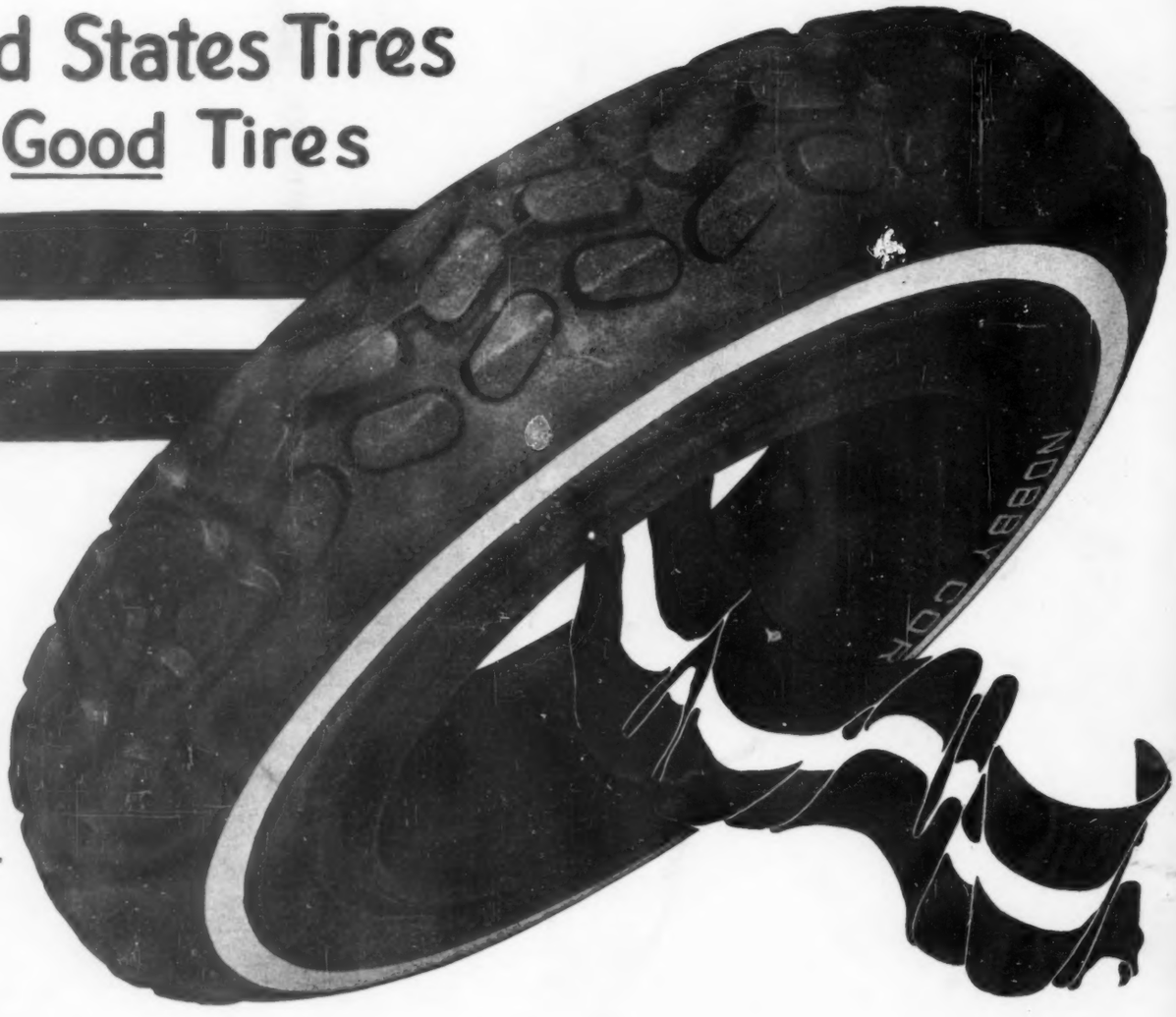

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